Relief map of the eastern Adirondacks

University of the State of New York

NEW YORK STATE MUSEUM

53D ANNUAL REPORT

OF THE

REGENTS

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3 January 1900

53d ANNUAL REPORT

OF THE

NEW YORK STATE MUSEUM

To the Legislature of the State of New York

I have the honor to submit herewith, pursuant to law, as the 53d annual report of the University on the New York state museum, the reports of the director of the museum and state geologist, of the paleontologist, of the botanist and of the entomologist, with appendix.

Anson Judd Upson
Chancellor

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New York State Museum

REPORT OF THE DIRECTOR 1899

To the Regents of the University of the State of New York

I have the honor to submit herewith my official reports, as director of the state museum and as state geologist, for the fiscal year ending Sep. 30, 1899. The results accomplished in fulfilment of the duties of these two offices are discussed in the following pages.

The work of the state museum in its various branches has steadily developed with the increase of appropriations, so that the director is enabled to communicate more extensive and valuable results for the past fiscal year. These results are discussed under the heads of geology, paleontology, mineralogy, ethnology, general zoology, entomology and botany.

Under the statutory requirements providing for a separate edition of the report of the state geologist, that part of my communication is made distinct in order that it may, so far as necessary, be distributed in a separate binding.

In order to permit of the wide distribution of separate papers, the reports are chiefly administrative. All communicated papers giving the results of completed investigation are, so far as possible, issued as bulletins which can be distributed without expense to the museum. A list of the bulletins accompanying this report will be found in the table of contents. Succeeding the administrative report is a list of accessions to the collections of the museum for the year ending Sep. 30, 1899.

Respectfully yours

FREDERICK J. H. MERRILL

GEOLOGY

The work of the state geologist during the 10 months which have elapsed since his appointment Jan. 1, 1899, to succeed the late Prof. James Hall, has been prosecuted under his direction by seven field assistants. The investigations in progress are naturally grouped in three divisions, pure geology, economic geology and the preparation for the graphic expression of both in the new edition of the geologic map.

Southeastern New York

The work in pure geology has been chiefly devoted to the study of the crystalline rocks in New York, Westchester and Putnam counties and specially directed toward the completion of those particular studies on the crystalline rocks of southeastern New York begun by the present state geologist in 1881 and continued at intervals since that time. Some results of this work have already been published under the titles of "Metamorphic strata of southeastern New York,"[1] "Geology of southeastern New York,"[2] etc. This work has been of particular value in view of the large commercial and educational interests now centered in the enlarged area of New York city and has been carefully elaborated, with a view to the development of fuller detail and accuracy in the geologic maps of Greater New York.

The investigation of the crystalline rocks of Westchester and New York counties has been carried on during the past field season by Mr Edwin C. Eckel, who deserves credit for his energy and the accuracy of his observations. Mar. 6, 1899, he commenced field work in southeastern New York. From that date till April 20 he was engaged in visiting and mapping such outcrops of the crystalline rocks as are now visible on Manhattan island. The rapid northward growth of New York city has resulted in the obliteration of many of the outcrops formerly noted, while excavations for streets and the foundations of buildings are continually furnishing new exposures, many of which are of con-

[1] Am. jour. sci. 3d ser. 39: 383-92.
[2] 50th an. rep't N. Y. state mus.

siderable scientific interest. As very accurate, large scale topographic maps were available, the boundaries of the various formations were determined rather more closely than had heretofore been possible. Recent cuttings for streets in the northern part of the island showed that the crystalline (Inwood) limestone is injected in many places with coarse grained rocks (aplites or pegmatites), usually approaching the granites in mineral composition. One well marked and somewhat extensive type, however, consists essentially of albite and quartz. Specimens were taken from all the outcrops visited. Records of borings made for wells, foundations, bridges and docks were collected.

At the close of this work on New York island, Mr Eckel was instructed to commence work in Westchester county. From April 20 to September 20 he was employed in a final review of that part of Westchester county lying south of the line Dobbs Ferry-Whiteplains-Larchmont. Critical outcrops were examined and specimens taken, while the boundaries of the various rock areas were carefully traced, preparatory to the publication of the final map of the region both in the New York geologic folio of the United States geological survey[1] and in the report of the state geologist. This final field work on the Harlem sheet, advisable in view of the great importance of the area mapped, both in geology and commerce, proved incidentally the great accuracy of the "Geologic map of a part of southeastern New York" published in 1895. With the exception of one small belt of Inwood limestone, uncovered by recent excavations, no features of areal importance were developed additional to those shown on that map. Particular attention was paid to the condition of the quarry industry throughout the region covered, specially in the areas of Inwood limestone and Yonkers gneiss. Statistics regarding both building stone and road materials were gathered and full sets of specimens collected.

Late in September the small area of crystalline rocks exposed on the western end of Long Island was examined and mapped

[1]The geology of the Harlem sheet will be issued from the office of the U. S. geological survey at Washington in the autumn of 1901 and a duplicate edition will be issued at the same time by the New York state printer.

accurately. The outcrops show that most of this area consists of a highly foliated quartz diorite, intrusive in the Fordham gneiss, the latter formation being exposed at a few points only.

The revision of the geology of Putnam county has been outlined by a reconnaissance made during August, September and October by Benjamin F. Hill, fellow of Columbia university, following on the brief study of the valley of the Hudson in Putnam and Orange counties made during the previous summer by D. H. Newland. This work, while technical in character, and chiefly a contribution to our knowledge of the crystalline rocks, is of much general interest in that it is a prerequisite to the publication of the new geologic map of the state of New York.

Adirondack geology

Work in the great field of study of the pre-Cambrian rocks of the Adirondack area has been continued by three geologists, all well known as authorities in this branch: Prof. J. F. Kemp, of Columbia university, Prof. H. P. Cushing, of Adelbert college, Cleveland (O.), and Prof. C. H. Smyth jr, of Hamilton college.

The field work in charge of Prof. J. F. Kemp was chiefly done by his assistant, Benjamin F. Hill, during June and July. The main object was to cover points not reached in previous summers. Mr Hill proceeded first to Sprakers in the Mohawk valley and studied the outlier of crystalline rock brought up by a fault from beneath the Paleozoic at that point. He then moved to Gloversville and explored the country adjacent to it. From Gloversville he changed his base to Caldwell and mapped the crystalline rocks at the southern end of Lake George, and, going thence to North creek, gave special attention to the geology of the garnet deposits and traversed the country just west of Thirteenth lake.

Prof. Cushing's field work commenced at Tupper lake, Franklin county, proceeding north from there along the New York and Ottawa railroad, following the boundary between the anorthosite and the adjoining rocks on the west, which consist largely of syenites, in the endeavor to determine the time relations between the two. A locality was found near Tupper lake where a rock,

believed to be augite-syenite, was plainly intrusive in the anorthosite at that point and hence younger. No other contacts could be found. Some territory, previously unvisited, was mapped. Next a section was run across the main anorthosite mass from Blue pond on the New York and Ottawa railroad to Saranac, by way of Saranac Inn. Except for frequent dikes of granite and gabbro, the anorthosite extends unbroken from one locality to the other. It had previously been assumed to do so from its occurrence at the two extreme points. Incidentally, interesting observations were made on the topography of the lake belt, and some evidence of the existence of a large glacial lake in the belt was gathered.

The remaining time was utilized in detailed work in that part of Clinton county which is comprised in the southern half of the Mooers quadrangle of the topographic atlas, constituting portions of Chazy, Beekmantown, Altona and Dannemora towns. Formation boundaries were mapped in detail and progress made in mapping the glacial deposits of the district. A detailed report of the results obtained is given hereafter, and the economic geology of the area is also discussed. Quarries have been recently opened on Rand hill and Dannemora mountain, and a boring for oil is in progress at Morrisonville.

The region studied by Prof. C. H. Smyth jr embraces the town of Alexandria and parts of Clayton and Theresa in Jefferson county, together with parts of Rossie and Hammond in St Lawrence county. Within this area are included the well known Thousand islands of the St Lawrence river. The rocks of the region consist of a continuation of the crystalline rocks of the Adirondack region together with the Potsdam sandstone in large amount.

The crystalline rocks, which were the main object of study, show the various types found farther south, which have been described in previous reports. The crystalline limestone group, or Oswegatchie series, of this and previous reports is exhibited in great variety, showing many schistose members and, what is rare elsewhere, heavy masses of vitreous quartzite. This formation is

penetrated by a complex assemblage of granites and granite-gneisses, which, though closely related, belong to at least two different periods of intrusion. Still later dikes of diabase mark the close of igneous activity, all of which occurred during the pre-Cambrian. The results of the season's work are perfectly in harmony with the conclusions drawn from earlier studies elsewhere in the crystalline area, and several localities were found which afford information of great value as standards of comparison.

The Potsdam was studied only in its relation to the crystallines, and the conclusion was reached that the sandstone was deposited on an uneven surface, analogous to the present surface of the crystallines.

Till four years ago comparatively little work had been done in the vast area of the Adirondack wilderness. The geologic boundaries could not be definitely drawn, and the classified statements were of questionable accuracy and in many cases out of date. To map this area with some degree of practical accuracy seemed one of the most pressing pieces of work and of very great value in both pure and economic geology. The study of this field was begun in 1892 at the request of the writer by Prof. J. F. Kemp and published in the 48th report of the state museum. Subsequently the field was in a measure divided between Prof. Kemp, Cushing and Smyth under the direction of Prof. James Hall. Of the particular detailed work of the past summer, the three observers in the field have prepared individual reports which are outlined above and are given in full in the following pages. The work of the three preceding years has already been published in the reports of Prof. James Hall.

Economic geology

In economic geology, my assistant, Dr Heinrich Ries, has completed his revision[1] of the report on *Clay industries*, published in 1894, and has spent a part of the field season in preparing material for the publication of a report on lime and cement.[2] This report has long been needed, and will be of much value to the

[1] See N. Y. state museum. Bul. 35.
[2] See N. Y. state museum. Bul. 44.

public. About four weeks altogether were spent in the field by Dr Ries, and the work during this period was along three lines: first, a more detailed sampling of some of the quarries than was possible in 1898 with the funds then available, second, visiting some of the lime and cement quarries which had not hitherto been examined, third, the study of the marl deposits of the state.

Several localities were visited between Glens Falls and Chazy, at which latter locality some new quarries are being opened that may form the basis of a portland cement industry in that region. In addition to notes on the quarries, samples were collected for analysis, and photographs made of the exposures. A number of places were also visited between Littlefalls and Buffalo, being chiefly those where the cement rocks were being worked. Along this same general belt, marl beds were visited, as at Warner, East Jordan, Caledonia, Wayland, Perkinville and Cortland. The outcrops of the Tully limestone in the Finger lake region were also examined. A reconnaissance was also made across the Great swamp from Albion to Batavia in the hope of finding marl deposits underlying that region. Careful inquiry failed to develop the presence of any along that line. Large ones however occur at Clarendon. Another aim has been to examine the localities mentioned by Beck in his report on the mineralogy of the state. Some of these, so far as can be determined, seem to be wrong, others are correct, and some of them have still to be investigated.

In addition to the work of Dr Ries, Prof. I. P. Bishop, of Buffalo, has been occupied in the collection of data regarding the development of the oil and gas territory in western New York. The investigation embraced a study of new wells bored since 1897 in northwestern New York, the collection of information regarding the supply and permanency of gas in the older fields and a survey of the oil and gas territory in Yates, Schuyler, Steuben and Allegany counties which were not covered by previous reports. As far as possible, the amount of gas and the manner of utilizing the supply have been ascertained. A surface map showing the extent of the oil pools and gas territory in southern Al-

legany county has been prepared for publication and accompanies this report. In addition to the work already outlined, records of a few wells in Chautauqua and Cattaraugus counties and of the Jordan and Memphis wells near Syracuse are included. Excepting the developments in Chautauqua and Cattaraugus counties within two years, the work of Professors Orton[1] and Bishop now covers all oil and gas territory west of the meridian of Auburn.

The reports of these gentlemen together with those of J. N. Nevius on the slate and emery industries form an important contribution to the economic geology of the state. While New York is not rich in the precious metals, it contains mineral deposits of much commercial value, and it is the definite policy to put in popular and practical form all such results of geologic investigation as will be of interest and value to the inhabitants of the state, from whose money this department of the University work receives its support.

Geologic map

In the preparation of a new geographic base for the new large scale geologic map, of which a preliminary edition was issued by Prof. James Hall, C. C. Vermeule has been engaged during the summer in reducing, by photography, the new topographic atlas sheets which are being prepared by cooperation between the state government and the United States geological survey, and making from them a tracing which will subsequently be reduced by photography to form a photolithographic base on the scale of five miles to the inch. In this work only the most reliable material will be used, and, while it is a somewhat slow process, the compilation, when completed, will be of great value to the citizens of the state, not only as a medium for communicating its geology, but for the ordinary educational and commercial uses of maps.

As it appeared that the edition first issued was somewhat unmanageable in character, being supplied only as a wall map mounted on rollers, the precaution has been taken to prepare the new map in sheets of only half the size of those adopted in the first edition. These, either with or without the geology, can be bound in an atlas, and for office use or for the ordinary purposes

[1] See N. Y. state museum. Bul. 30.

of study will be found more convenient than a wall map. The sheets are, however, so planned in the details of border, legend, etc., that they can readily be mounted on rollers and formed into a wall map of precisely the same scale as that of the first edition.

In preparation for the publication of a new edition of the economic and geologic map published in 1895, some preliminary drafts have been made to determine what amount of the available geologic detail could be shown on the scale of 12 miles to the inch, which has been adopted for the new edition.

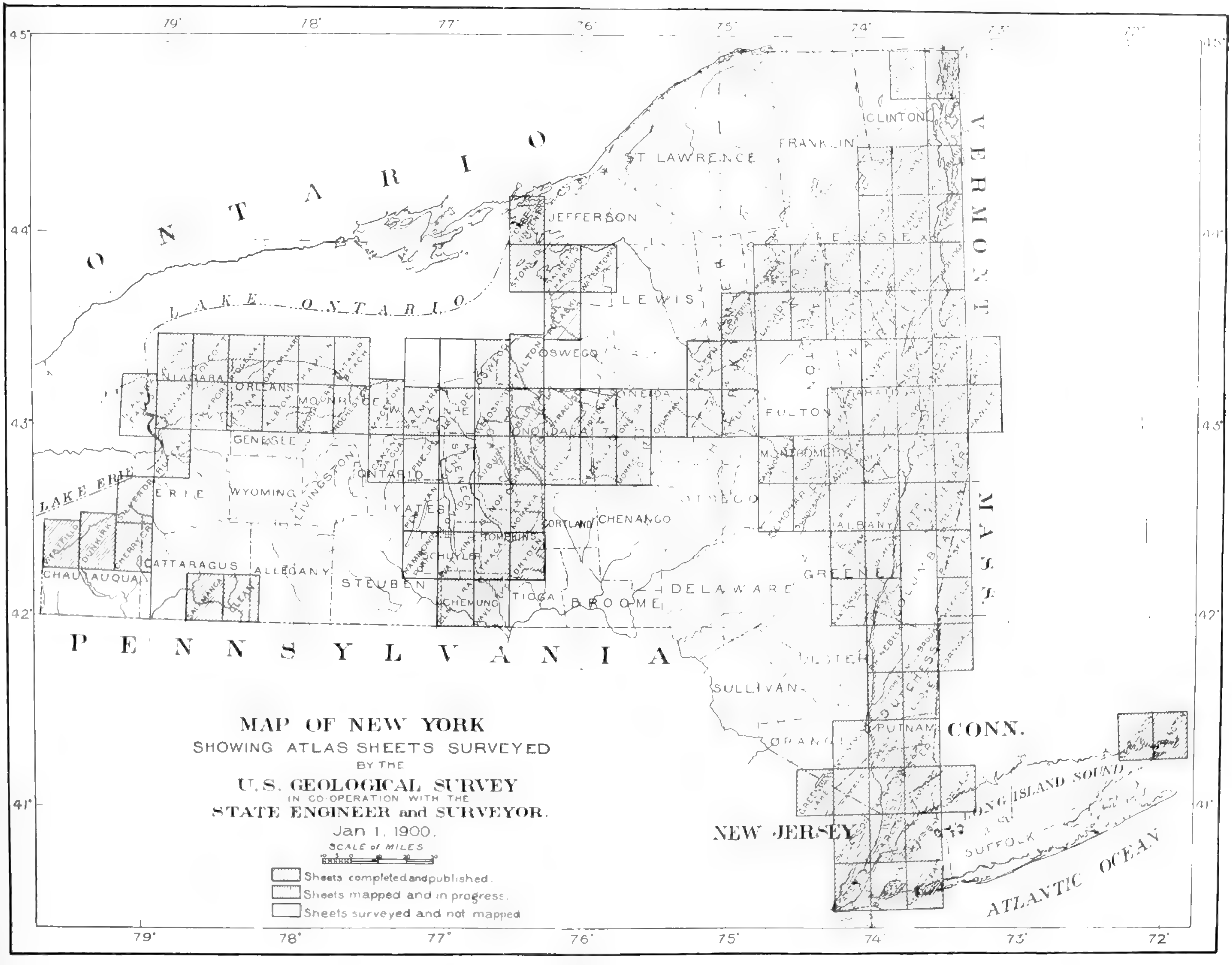
Topographic sheets

In view of the many inquiries received by the state geologist in reference to the topographic maps published by the United States geological survey, it has been thought desirable to prepare a brief statement of the conditions of publication and distribution of these maps.

For the past 18 years the United States geological survey has been engaged in making a topographic survey and map of the United States. In most of the older states this work has been carried on in cooperation with the respective state governments. In New York the mapping is under the joint supervision of the United States geological survey and the state engineer and surveyor, the expense being equally divided between the state and the federal government. The state is entitled to gelatin transfers from the plates of the several atlas sheets whenever it desires to undertake the printing thereof; but because of the better facilities for this work at Washington, no printing has yet been done by the state. Up to the present time 106 atlas sheets covering about two fifths of New York state have been published. The accompanying index map (pl. 2) shows the name and location of each of these sheets.

The unit of map publication is an atlas sheet 16½ inches wide by 20 inches high. Two scales are used. One is 1:62500, or about 1 mile to 1 inch; the other 1:125000, or about 2 miles to 1 inch. Maps of all the areas, as surveyed, are published originally on the first-mentioned or mile scale. An atlas sheet

To face p. r14


MAP OF NEW YORK
SHOWING ATLAS SHEETS SURVEYED
BY THE
U. S. GEOLOGICAL SURVEY
IN CO-OPERATION WITH THE
STATE ENGINEER and SURVEYOR.
Jan 1. 1900.
SCALE of MILES
Sheets completed and published.
Sheets mapped and in progress.
Sheets surveyed and not mapped
ONTARIO
LAKE ONTARIO
LAKE ERIE
PENNSYLVANIA
VERMONT
MASS.
CONN.
NEW JERSEY
LONG ISLAND SOUND
ATLANTIC OCEAN
ST LAWRENCE
FRANKLIN
CLINTON
JEFFERSON
LEWIS
ESSEX
OSWEGO
ONEIDA
FULTON
NIAGARA
ORLEANS
MONROE
WAYNE
ONONDAGA
GENESEE
ERIE
WYOMING
LIVINGSTON
ONTARIO
YATES
CORTLAND
CHENANGO
OTSEGO
MONTGOMERY
ALBANY
GREENE
SCHUYLER
TOMPKINS
CHAUTAUQUA
CATTARAGUS
ALLEGANY
STEUBEN
CHEMUNG
TIOGA
BROOME
DELAWARE
ULSTER
SULLIVAN
ORANGE
PUTNAM
SUFFOLK
79°
78°
77°
76°
75°
74°
73°
72°
45°
44°
43°
42°
41°

on this scale shows a tract (quadrangle) 15 minutes in extent each way, being one sixteenth of a "square degree", or about 220 square miles, the area varying with the latitude. An atlas sheet on the second-mentioned or two mile scale is made by the reduction and combination, omitting some details, of four of the mile scale sheets, and represents a tract (quadrangle) 30 minutes in extent each way, being one fourth of a "square degree", or about 880 square miles. A few of these have been published. On the annexed map the small rectangles indicate one mile scale sheets. A sheet is designated by the name of some well known place or feature appearing on it. The names of adjoining published sheets are printed on the margins.

The maps are engraved on copper and printed from stone. The cultural features, such as roads, railroads, cities, towns, houses, etc. as well as the lettering, are in black; all water features, swamps, etc. are in blue; while the hill features are shown by brown contour lines, the contour interval being 20 feet.

An act of congress prescribes that the maps shall be disposed of by sale. They are accordingly sold at the rate of 5 cents a sheet. For 100 or more in one order, whether of the same sheet or of different sheets, the price is 2 cents a sheet. All correspondence relative to the purchase of maps should be addressed to the Director, United States Geological Survey, Washington D. C.

Museum work in geology

In economic geology important progress was made in the rearrangement of the economic collection and the installation of a large suite of specimens representing the petroleum, salt, talc, garnet, graphite and slate industries of New York. The geographic distribution of each material was, in each exhibition case, illustrated by a small map.

In historic geology the year's work has been marked by the enlargement of the synoptic collection, among the material contributions to which may be enumerated the donation of a series of 19 specimens to illustrate the Carboniferous and sub-Carboniferous of Pennsylvania, by Prof. J. J. Stevenson of the Univer-

sity of the City of New York, and four specimens representing the upper and middle Washington limestones from Washington (Pa.), by Prof. Edwin Linton of Washington and Jefferson college, Washington (Pa.). In addition to the above, Mr Nevius has completed the mounting of the large fossil plant collected at Monroe, Orange co. (N. Y.) during the previous year.

In June of the present year Mr Nevius resigned his position as assistant curator to accept an appointment with the San Carlos copper co., in Mexico.

In conclusion the state geologist desires to express his appreciation of the unusual courtesy he has experienced from the members of both houses of the legislature, to whom he has had the honor and privilege of presenting the claims and needs of the geologic work of the state in the matter of financial support, and who have received his statements with an instant appreciation which has given him heart and courage quite as much as did the substantial appropriations made through their good will.

PRELIMINARY REPORT ON THE PRE-CAMBRIAN FORMATIONS IN PARTS OF WARREN, SARATOGA, FULTON AND MONTGOMERY COUNTIES

BY

J. F. KEMP AND B. F. HILL

Dr F. J. H. Merrill *State geologist*

Sir: I have the honor to submit herewith a report on the pre-Cambrian formations in parts of Warren, Saratoga, Fulton and Montgomery counties. The field-work was chiefly performed by Benjamin F. Hill in 1899 acting under my direction, but the report has been written by myself.

Respectfully

J. F. Kemp

24 Dec. 1900

CONTENTS

ILLUSTRATIONS

PRE-CAMBRIAN FORMATIONS

IN PARTS OF

Warren, Saratoga, Fulton and Montgomery Counties

Warren county

A brief topographic outline of Warren county was prepared for one of our previous reports.[1] Complete geologic work is still handicapped by the lack of topographic maps in the southwestern part. The following quadrangles (i. e. the area embraced by a topographic sheet, being 15 minutes of latitude by 15 minutes of longitude) are wholly or in part in Warren county and have been published. Newcomb, Schroon lake, Paradox lake and Ticonderoga just cross the northern boundary. Thirteenth lake, North creek, Bolton and Whitehall form the next tier to the south. Glens Falls takes in the southeastern corner.

Maps and geologic descriptions of the following towns will be found in the report of the state geologist for 1897, the same having been prepared by J. F. Kemp and D. H. Newland: Bolton, p. 533; Chester, p. 535; Hague, p. 537; Horicon, p. 541; Thurman, p. 543; Stonycreek, p. 544; Luzerne, p. 546. There remain Johnsburg, Warrensburg, Caldwell and Queensbury. Johnsburg is described in the report of the state geologist for 1898; Caldwell and Queensbury are contained in the following pages, and some notes are appended on Warrensburg. We have no topographic maps south of the middle line of Thurman and west of Caldwell, so that in Stonycreek, Luzerne and much of Warrensburg we have been at a disadvantage. The western border of the county is a wild and inaccessible district, and our observations there have been limited.

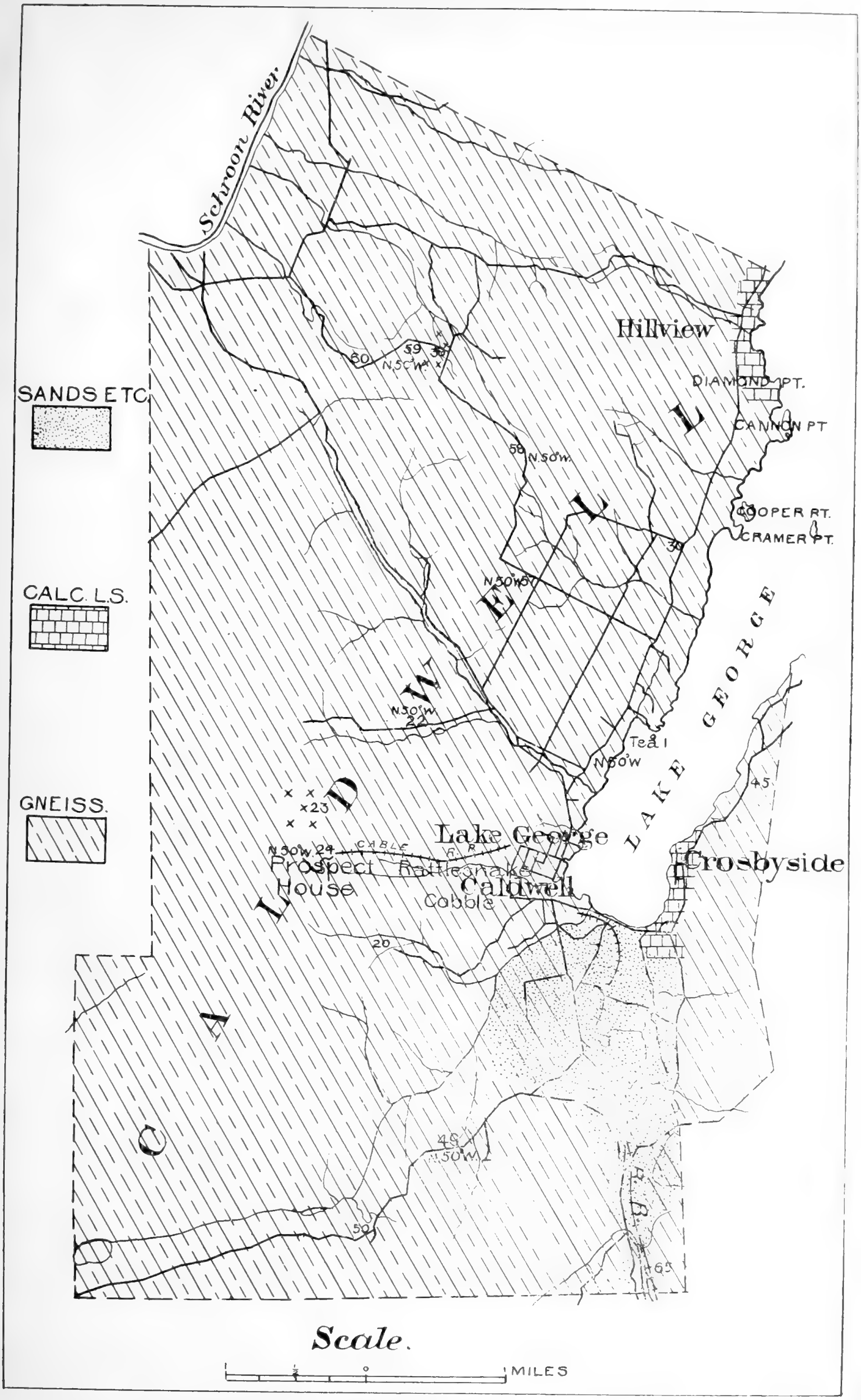
Caldwell

Caldwell lies at the head of Lake George, embracing the shore line on both sides. It is about 7 miles long from north to south

[1] 17th an. rep't N. Y. state geologist. 1897. p. 532.

and 4 to 5 miles broad from east to west. On the northwestern corner its line runs along the Schroon river, and the town contains the watershed between the Hudson and the Lake George–Lake Champlain–St Lawrence drainage systems. This divide extends nearly but not quite the entire length of the town, inasmuch as it veers to the southwest near the southwestern corner so that the outlet of a small pond at this point flows into Lake George.

As might be inferred from the above description, the topography of the town includes one long ridge and one large valley, the valley of Lake George. The ridge itself is cut in two by a northwest and southeast depression which is occupied by a large brook. The highest summits are on the western side of this brook, and in Prospect mountain, due west of the head of the lake, the altitude is just in excess of 2000 feet (exactly 2021) above tide. The northeastern part of the area is less rugged. On the southeast the town extends up on the slopes of French mountain, whose steep front, presumably an old fault escarpment, faces Lake George. This relation is coincident with others which have been noted to the eastward as far as Fort Ann. All the ridges, viz, French mountain, the ridge of Buck mountain, Pilot Knob and Sugar Loaf, Putnam mountain and the Pinnacle, present sharp fault scarps to the west and more gradual slopes to the east. There is little doubt that the large features of the topography are conditioned by these factors, and that Lake George lies in a depression primarily caused by them. The faults on each side of French mountain come together under the lake, but the eastern one is prolonged in Northwest bay and in its tributary valley. When the lake turns to the northeast at the mouth of the bay, it may lie in a *Grabensenkung*, or the valley formed by a pair of faults, whereby an intervening block is dropped. Faults similar to the above have been traced in the paleozoic areas on the south by N. H. Darton, and, indeed, the two on each side of French mountain have already been noted



Geologic map of town of Caldwell, Warren co. N. Y., by James Furman Kemp and Benjamin F. Hill

by him.[1] The eastern one can be followed as far south as Saratoga.

To the south of Lake George the valley is filled with sand, and every indication is afforded that the lake formerly extended much farther to the south. The divide near Bloody pond, between the Lake George drainage and the Lake Champlain drainage via Glen lake, Halfway creek and Wood creek, is almost imperceptible.

The rock formations, or hard geology, of Caldwell embrace gneiss, gabbro, and calciferous limestone, and, if the same provisional arrangement in series be followed as in our previous reports, they would be described as follows.

Series 1 The gneisses constitute the high ridges and adjacent foothills. The commonest variety is a light colored, rather acidic rock, of which we select specimen 30, from the crossroads on the lake shore, about 3 miles from the head of the lake, as the typical case. It is strongly foliated and has evidently been very severely squeezed in dynamic metamorphism. The foliation, which is made apparent by the dark silicates, is however due to the parallel alignment of many small, dark patches, which are not continuous. They might easily result from foliation induced by pressure in a rock originally massive and provided with a moderate percentage of dark silicates. Under the microscope it is evident that the component minerals are quartz, microperthite and hornblende, all greatly granulated. The mineralogy shows some marked resemblance to the syenitic rocks, described by H. P. Cushing from Loon lake, in the northern Adirondacks, but the rock is seldom as pronounced a green, and some hesitation is felt by us in drawing a more emphatic parallel than the statement of this mineralogic resemblance. If it could be shown anywhere that crystalline limestones were interbedded in the gneisses, we would be compelled to pronounce them sedimentary.

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[1] Darton, N. H. Geology of the Mohawk valley, 13th an. rep't N. Y. state geologist. 1893. p. 409, specially 425 and 429. Preliminary description of the faulted region of Herkimer, Fulton, Montgomery and Saratoga counties, 14th an. rep't N. Y. state geologist. 1894. p. 30, specially p. 52.

The gneisses are often quite rusty on exposed faces, more so than one would expect from rocks that are so light colored on unweathered surfaces.

The other exposures of rocks falling under the above description are in order from north to south (*see* map) nos. 59, 60, 58, (30), 22, 24, 25, 26, 28, 29, 50, 45, and 65. No. 49 is decidedly more basic and is a pronounced hornblendic gneiss, with hornblende in great excess. These basic bands are occasionally noticeable. No. 57 is a case in point.

The strike of the gneisses is quite uniformly n 60° w magnetic, or about n 70° w true, and this same bearing holds true over a wide area adjacent to the town.

Series 2 No crystalline limestones were observed in Caldwell, but they are known in neighboring towns.

Series 3 The eruptive gabbros are found in two places, one at no. 39 on the north and one at 23, northwest of the Prospect house, on the mountain of the same name. No. 39 is a well developed dike which is cut by a pegmatite vein, 8 inches thick. No. 23 has been examined with the microscope. It is greatly granulated and consists of large crystals of plagioclase, rendered opaque in the centers by a dust, probably of spinel and pyroxene, of garnet, hypersthene, brown hornblende, and green augite.

No dikes of the common basaltic kind were observed, anywhere in the town.

Calciferous limestone. Two exposures of this formation have been noted, both of which already appear on the state map. One runs along the shore of the lake in the northeastern corner of the town and one appears at the southeastern corner of Lake George. The latter may extend farther south under the sands. The rock is a dark, gray silicious variety, devoid of fossils, and the dip is flat. Each exposure is a block dropped in by faulting.

Queensbury

Topography. Queensbury is a very large town of an irregular shape. It extends from the Hudson river on the south at Glens Falls to Lake George on the north and forms the shore of the lake itself for about 4 miles. The town is 15 miles in

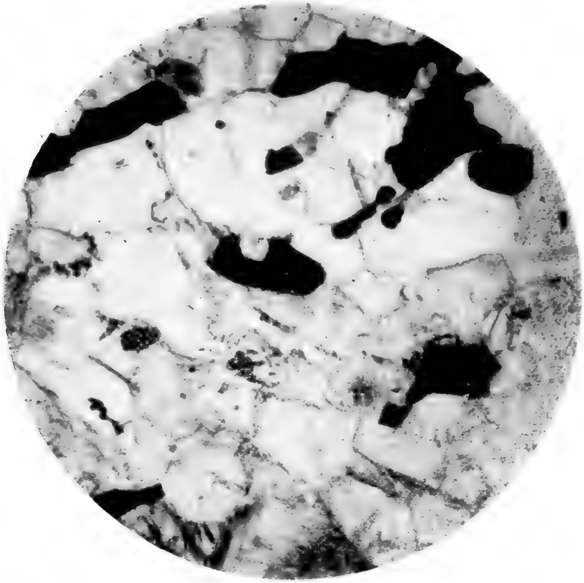


Fig. a Photomicrograph of a thin section of gneiss, × 25. White light. Specimen 45, Caldwell. The clear gray mineral is quartz; the mottled mineral micro-perthite; the dark mineral, hornblende

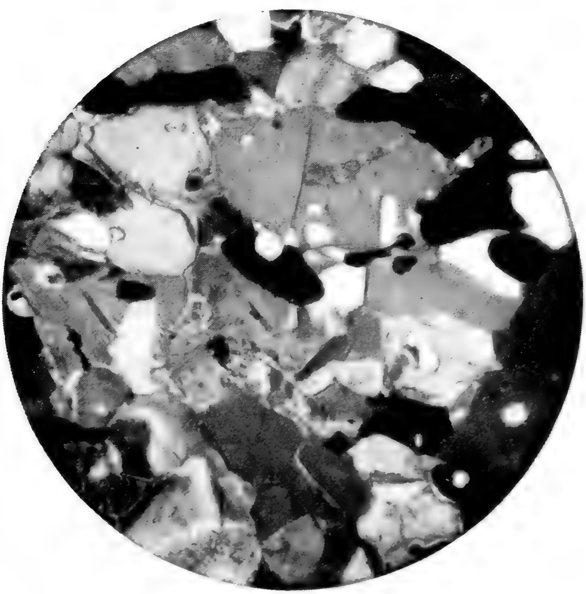


Fig. b Same as fig. a, but in polarized light, with crossed nicols

the extreme from south to north and about 8 miles from east to west. In the southern part, except along the western edge, it is a sandy plain, through which occasional ledges of Ordovician strata appears, more particularly near the Hudson. The plain is prolonged to the north in two valleys, one of which, the smaller, traverses Caldwell to the head of Lake George. The other, which is larger and more open, extends northward on the eastern side of the township and reaches Lake George some 3 miles from its head. Both these depressions are primarily due to faulting, as several observers, but more particularly N. H. Darton, who is cited under Caldwell, have already noted.

From the sandy plain and in marked contrast with it, Luzerne mountain rises abruptly along the western side, and attains an altitude of 1500 feet or more. It marks the boundary between Queensbury on the east and Luzerne on the west. Farther north French mountain forms an abrupt and isolated ridge along the boundary with Caldwell and separates the two valleys, just referred to, which extend to Lake George. The peaks of French mountain range from above 1400 to slightly more than 1500 at the extreme crest. Both French mountain and Luzerne mountain are gneiss, while the paleozoic strata lie in the valleys.

The northeastern boundary of Queensbury runs along the base of a high ridge of gneiss, of which Sugar Loaf, in the town of Fort Ann, is the southern extremity, but which is almost entirely in the latter town.

Geology. The large geologic map of the state gives the distribution of the geologic formations with such correctness that it seems unnecessary to redraw it at this time. Our attention being specially directed to the old crystalline rocks, we have given but passing notice to the paleozoic strata. The latter have however been studied by several observers within the last few years, and as noted below.

Mr Hill crossed Luzerne mountain on the highway due west of Glens Falls, and collected specimens 54 and 55, of the gneiss—that is the country rock. Specimen 55 is a green, granulated rock with a well developed foliation. When examined microscopically, it is found to be an aggregate of microperthite, orthoclase,

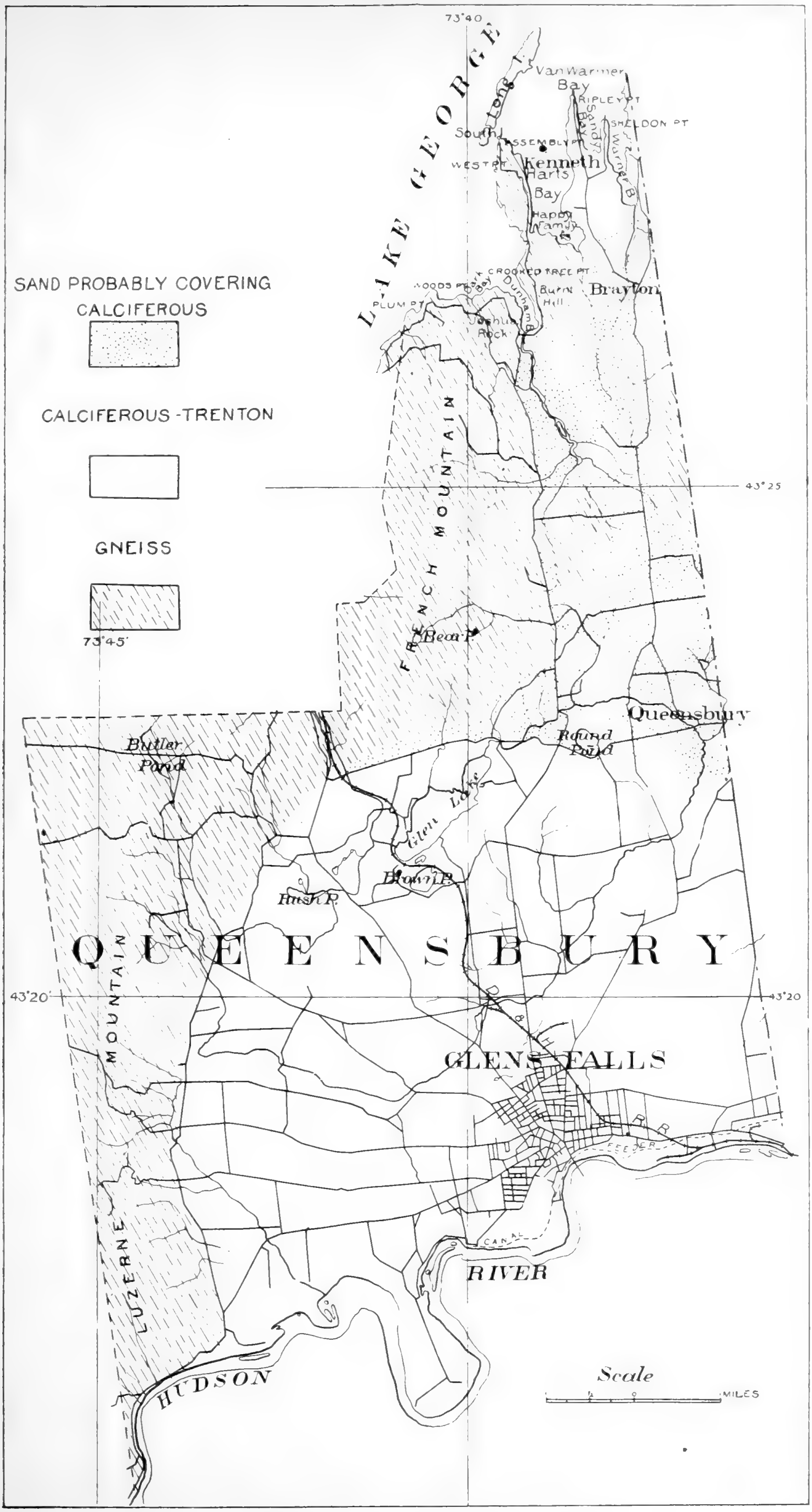
quartz, dark greenish brown hornblende and biotite. It presents all the characteristics of the group of syenitic rocks from Loon lake, referred to above under Caldwell. There is so much quartz present that the rock is really a granite, but we regard it as a metamorphosed igneous rock belonging to the general group, which Prof. Cushing has identified.

The gneisses at the northern end of French mountain are similar to these syenitic types, but differ enough to make one hesitate regarding the identity. At the south end there is a change however. Micaceous varieties with pegmatitic streaks are found, and the same is true of the southeastern corner of the town of Caldwell, but more complete observations would be necessary in order to work out the relations.

Of the paleozoic strata no Potsdam sandstone has been found in the town, but it may exist beneath the later strata, having been dropped out of sight by faulting. The Calciferous appears along the east side of French mountain, as observed by Mr Darton[1] and on the state map the entire valley, despite the mantle of sand, is colored as Calciferous. This would seem to be an error, as Mr Hill observed gneiss in the ridge which is crossed by the first east and west road south of Brayton, and that meets French mountain near its middle point. The limitations of the gneiss were not fully explored, and, indeed, there is so much sand all through the valley that the hard geology is largely a matter of inference.

The Trenton strata occupy the southeastern corner of the town and are well exposed in quarries at Glens Falls. Prof. Prosser records[2] $56\frac{1}{3}$ feet of undoubted Trenton in the quarries of Finch and Pruyn, with 2 additional feet of limestone of uncertain affiliations at the base. In the south bank of the river there is about 33 feet of higher lying beds, as shown by Dr Prosser's section below the paper mill.[3] Mr Darton has also recorded the presence of a small outlier of Trenton beds along the northeastern border about 2 miles south of East bay. Mr

[1] 48th an. rep't N. Y. state museum. 1894. 2:52.
[2] Bul. N. Y. state museum no. 34. v. 7. p. 480.
[3] ——— p. 482.



Geologic map of the town of Queensbury, Warren co. N. Y., by James Furman Kemp and Benjamin F. Hill

Hill did not happen to see this, and we have no farther details to add to the previously published description.[1]

The glacial and post-glacial deposits and the recent geologic history of this town are of surpassing interest, but they have not been sufficiently studied by us to be described at length. It is evident that Lake George once penetrated much farther up the depressed valleys than it does today, and that to it is largely due the great accumulation of sands. In the rearrangement of the drainage systems following the close of the glacial period some very peculiar situations have sprung up. Halfway creek, for example, has its rise in Luzerne mountain and flows eastward over the sandy plain, being at one point less than 2 miles from the Hudson. It then strikes away off to the northeast, crosses Fort Ann and discharges into Wood creek and Lake Champlain. To what extent the glacial and post-glacial deposits have modified earlier relations between Lake George and the Hudson is a subject demanding very thorough study.[2]

Warrensburg

Our work in Warrensburg has only been of a very fragmentary character, and we must await the issue of the U. S. geological survey map of the quadrangle south of the Northcreek sheet to give us a satisfactory base of observations. The town is a long and narrow one. In the extreme from north to south it is about 16 miles. As a maximum it is 6 miles from east to west, but at the village of Warrensburg it is scarcely more than 2. The town is divisible into two sharply contrasted parts. The northern lies between the valleys of the Schroon and Hudson rivers and is a blunt wedge of hilly country, whose highest summits are between 1600 and 1700 feet above tide, and about 1000 above the rivers. The wedge is about 10 miles from north to south. The southern part is not such a sharply marked topographic unit, but consists of the western slopes of the ridge which forms the divide between the Hudson and the head of

[1] 48th an. rep't N. Y. state museum. 1894. 2:52.

[2] The question has been briefly treated by G. F. Wright. Science, Nov. 22, 1895, p. 675.

Lake George. D. H. Newland in 1897 traversed the country from Chestertown to Warrensburg village along the main highway, and noted gneiss with occasional masses of gabbro. Mr Hill in 1899 crossed from Bolton to the Schroon valley and followed south through Warrensburg village along the river. He noted the usual gneiss of Caldwell but was impressed by the remarkable terraces along the Schroon river. One appears on each side about 20 feet above the stream and indicates an apparent rise in the land or the cutting of some barrier that has lowered the old outlet level.

Saratoga county

Some notes have been gathered regarding the nature of the gneisses in Saratoga county, which, though fragmentary, will be of interest, because they were made along the southern border of the pre-Cambrian areas, and, in many cases, just as the ancient crystallines disappeared under paleozoics or under drift. Unfortunately no topographic maps are as yet available in the crystalline areas of this county, and the lack of them has been a great handicap to accurate field work.

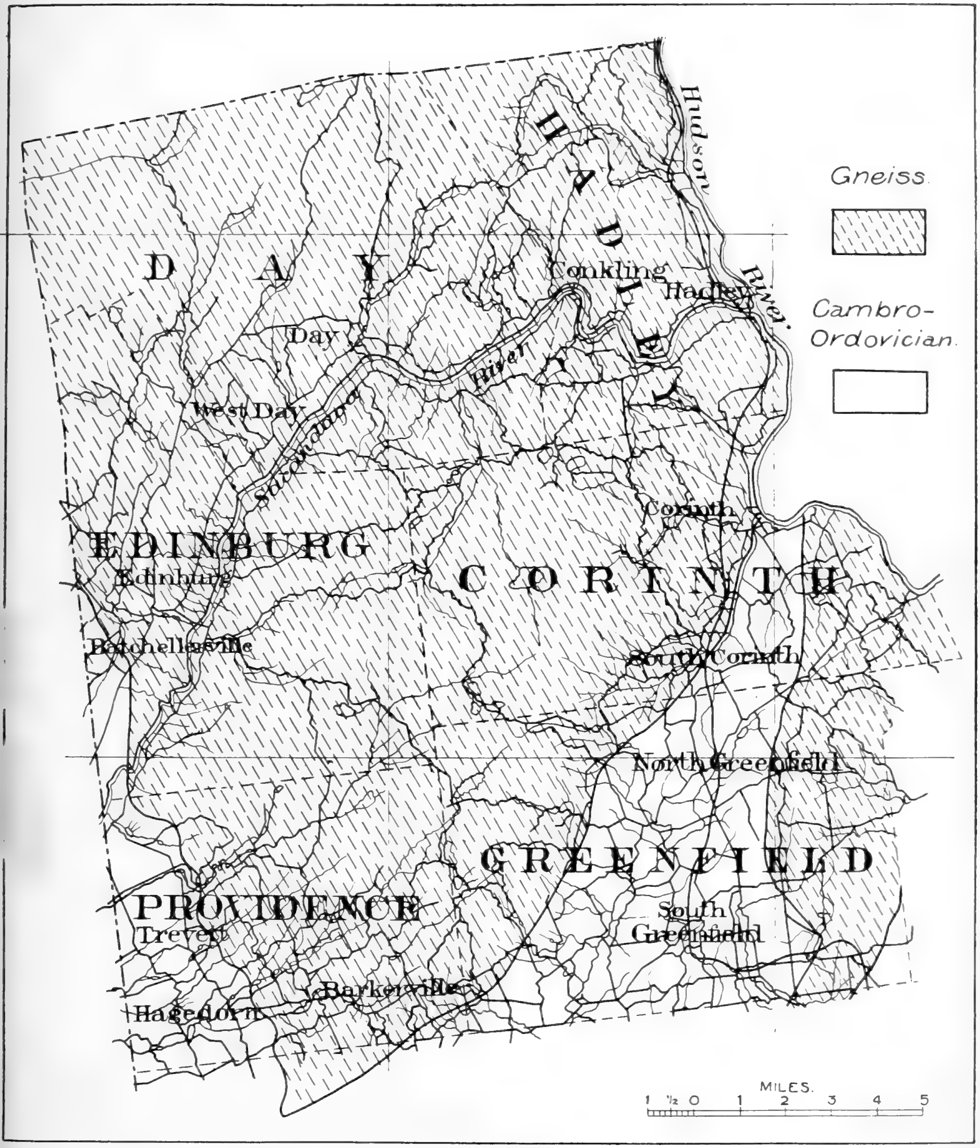
Day

Day is the extreme northwestern town of Saratoga county, and by mistake it and Hadley were mentioned in our report (1897) as being in Warren county.[1] Only the eastern part of Day was there taken up, and it was described as consisting of gneiss and glacial drift. The same is true of the western part. Mr Hill has made a trip to Mud lake in the northwest part of the town, and finds only gneiss. The commonest variety consists of biotite, quartz, feldspar and light pink garnets. At times the garnets disappear. Dark hornblendic varieties were much more rarely observed. The strike at Mud lake is north and south.

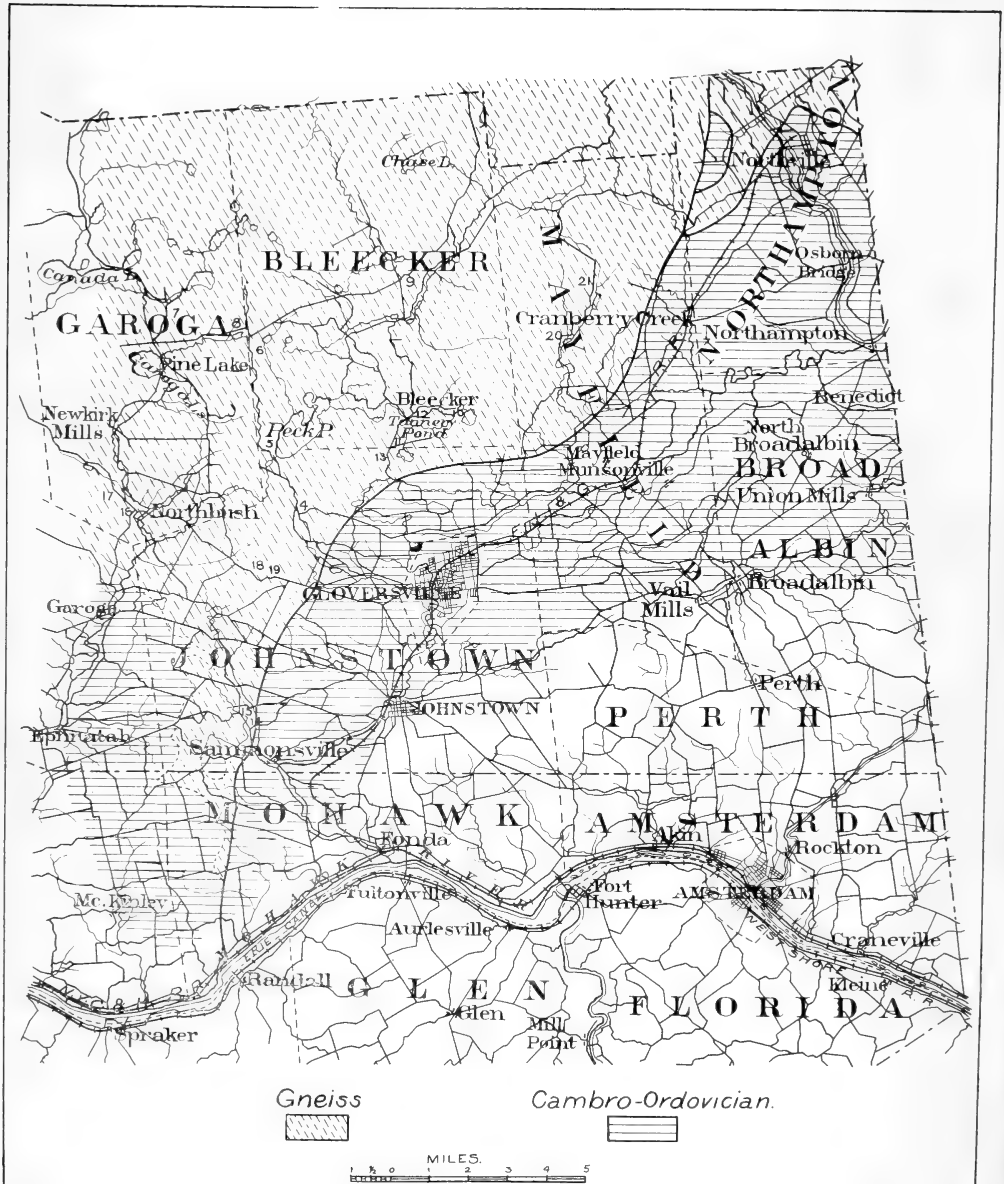
Edinburg

Edinburg lies south of Day and is gneiss and drift except for a narrow belt of Potsdam along its southwestern border. The

[1] 51st an. rep't N. Y. state museum. 1897. p. 546.



Geologic map of the northern part of Saratoga county, N. Y., by James Furman Kemp and Benjamin F. Hill



Geologic map of the northern portion of Fulton county, N. Y , by James Furman Kemp and Benjamin F. Hill

gneiss begins near the northeast bend of the Sacondaga river, at Fish house, and extends thence, eastward and northward, across the town. To the west of Batchellorsville a very light colored, garnetiferous feldspathic variety was gathered, that has been severely granulated and sheared, but as a rule the rock appears to be the micaceous, garnetiferous variety noted under Day. The garnetiferous gneiss is extensively developed in Steele mountain to the southeast of Batchellorsville, and has been observed beyond Mt Pleasant in Greenfield. It seems to be quite characteristic of this general region, and, as will be noted later, it is very abundant at the "Noses" in Montgomery county. It would appear to be an altered sediment.

Wilton and Greenfield

A large ridge of gneiss runs along the border of these two towns, which embraces Mt McGregor and thence runs northward in Luzerne mountain. It is hornblendic and varies in strike from n 40 w to n and s. Its dip is steep, and its general character is the same as has been described under Queensbury.

Fulton county

Fulton county lies west of Saratoga, south of Hamilton and north of Montgomery. It is roughly rectangular in shape, with its greatest dimensions extending east and west. It contains the southern limits of the old crystalline rocks in this part of the Adirondack area except for the small faulted outlier at the "Noses". The edge of the crystallines runs in a southwest direction across the country and follows the escarpment of the "Noses" fault, the older rocks being brought up by it against the paleozoics on the east. The topographic maps thus far prepared only touch this county along its southern border and scarcely affect the gneisses.

Bleecker

Bleecker is a rectangular town in the center of the northern tier of Fulton county. It lies wholly within the area of gneiss and, except for the ever present glacial drift, it displays

no other formations. The northern part of the township is wild and unsettled, but the central and southern parts are well opened by roads. Our observations have been chiefly limited to the latter, but there is little doubt that the same rocks cover all the area, unless gabbro dikes give local variety. Topographically the township consists of a series of ridges with intervening valleys.

Specimen 5 from the southwestern corner is a micaceous gneiss of the general mineralogy of granite. Pegmatite lenses run parallel with the foliation. The strike is n 20 w magnetic. No. 6, from a point 2 to 3 miles north and on the western border, is a dark, massive gneissoid rock, probably one of the syenitic series that is so largely developed in the townships just north in Hamilton county. Related types occur in Garoga township at 8 and 7. No. 9, from near the center of the township, is a most interesting rock. To the eye alone it is a very finely laminated quartzose gneiss, almost a quartzite. It has been greatly mashed and granulated. Under the microscope it is chiefly quartz, but contains in addition abundant needles of sillimanite and not a few garnets. (*See* pl. 8, fig. a.) It is quite certainly a metamorphosed sandstone, which contained originally considerable aluminous material and some lime. Its strike is n 80 w magnetic.

No. 10, from the east end of Tannery pond, is a micaceous gneiss, consisting chiefly of copper colored biotite and greenish feldspar. Its strike is e and w, magnetic, dip, 45 s. No. 12, from Bleecker postoffice, is the same as 10, but strikes n and s magnetic. No. 11 is a dark, rusty hornblendic gneiss.

Garoga

Garoga lies west of Bleecker. Through its center passes the meridian which marks the boundary between the area studied by Prof. C. H. Smyth and that covered by us. Like Bleecker, Garoga is wholly within the area of gneiss. Two large lakes are contained within its boundaries, viz Canada lake and Garoga lake.

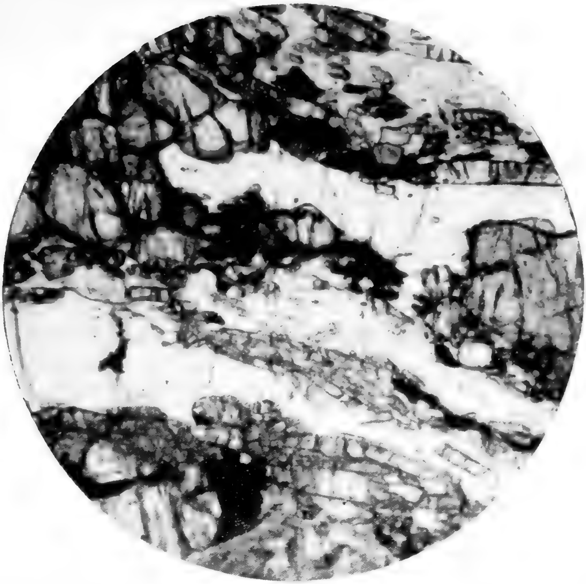


Fig. a Photomicrograph of a thin section of sillimanite gneiss, × 25. White light. Specimen 9, Bleecker. The rods with cross-fractures are sillimanite; the clear mineral is quartz; the angular mineral with dark edges is garnet

Fig. b Photomicrograph of a thin section of gneiss with lenses of quartz, × 19. White light. Specimen 16, Garoga

Specimens 7 and 8, from the country just east of Canada lake, are dark syenite or dioritic gneiss. No. 7 has streaks of quartz running through it, parallel with the foliation (*see* pl. 8, fig. b), but no. 8 is quite massive and decidedly igneous in its appearance. Nos. 16 and 17, from the southern portion of the township, are in strong contrast with 7 and 8. They are light colored feldspathic gneisses, tightly compressed and finely foliated. Streaks of biotite, apparently rubbed out by the shearing action, run through them. Under the microscope no. 16 is seen to consist chiefly of quartz, which is sometimes rolled out in thin lenses and sometimes greatly granulated. Orthoclase and plagioclase are both present, and biotite appears in important amount.

Johnstown

Johnstown is a large town which lies south of Bleecker and Garoga. The great fault scarp which passes northward from the "Noses," crosses the town from its southwestern corner toward the northeast. About one third the area is pre-Cambrian, and the remainder consists of the paleozoics. Heavy drift lies on both and serves to conceal the outcrops. A second fault that runs off through the town of Palatine meets the "Noses" fault and serves to bring the paleozoics to the surface along the western border.

Specimens 18 and 19, whose location is shown on the map, are porphyritic or augen-gneisses, somewhat different from any mentioned elsewhere in this report; 18 is a light colored feldspathic variety, whose dark silicate is biotite. Quartz is fairly abundant but is inferior in amount to the feldspar. Large crystals of red orthoclase, which are in contrast with the light green of the prevalent feldspar, are distributed through the rock. No. 19 is a much more micaceous variety, but it still exhibits the porphyritic crystals of feldspar. Nos. 14 and 15 were obtained from a ridge of gneiss just east of Kecks Center. They are finely laminated feldspathic gneiss, having apparently the general composition of granite. They have been greatly compressed and have a close and extremely regular foliation. The strike is n 20 w magnetic.

The details of local geology were taken from the state map of 1894. Till the topographic sheets from the U. S. geological survey are available, it will hardly be feasible to perform more detailed work, but with proper maps some slight rearrangement of boundaries may be possible. Meantime, the above notes will serve to give some idea of the character of the gneisses.

Mayfield

Mayfield lies east of Bleecker and is a long, narrow town, of which about half is gneiss and half paleozoics. The great fault scarp, which begins at the "Noses" on the Mohawk, passes across the town in a northeast direction. On the southeast the paleozoics have been dropped and preserved by the fault, while on the northwest the gneisses have alone survived. Specimens 20 and 21 from the central part of the township are hard, dark gray gneisses. When studied in their section they are not so basic as they appear to the eye. Quartz is much the most abundant mineral, biotite is next, and the remainder of the slide is garnet and a little orthoclase. In the ridge along the eastern border of the town the gneiss is lighter colored and is very finely laminated. It has been very greatly crushed and rubbed out into laminae, with much biotite along the surfaces of movement. It apparently contains more feldspar than no. 21, but both give a strong impression of being derived from altered sediments.

Montgomery and Fulton counties

The "Noses"

The exposures of the old crystalline rocks which are brought to the surface by the combined anticline and fault at the "Noses," on the Mohawk river, are of great scientific interest, because, except for the similar exposures at Littlefalls, they are the last opportunities that we have to observe this formation, before it dips beneath the great area of paleozoics. The "Noses" is the name given to the bold headlands which are situated between Fonda and Canajoharie, and which rise from the Mohawk with almost precipitous escarpments to a level of 500 feet above the

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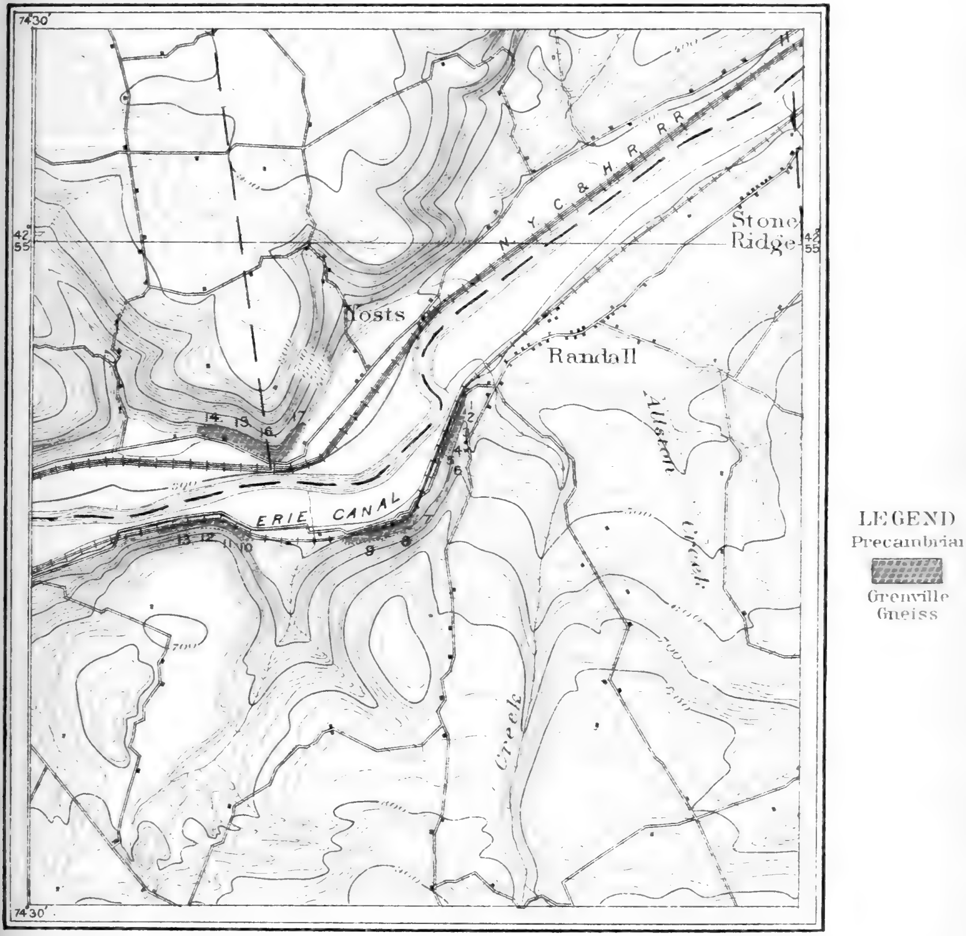

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OUTLINE MAP OF THE "NOSES"
MONTGOMERY AND FULTON COUNTIES
BY
JAMES FURMAN KEMP
AND
BENJAMIN F. HILL

Scale $\frac{1}{62500}$

1 ½ 0 1 Mile

Contour interval 20 feet.

Datum is mean sea level.

river. An anticline whose axis is crossed by the river is partly accountable for the exposures of the basal strata. Its axis seems to lie along the brook which flows into the Mohawk from the south, about a mile west of the Little Nose. The great fault, which is called by Darton the "Noses fault," begins south of the river and bears off to the northeast in a somewhat sinuous course, finally terminating, so far as present knowledge goes, in the Sacandaga valley, Hope town, Hamilton co. This fault and its influence on the topography of the country early attracted attention, and the subjoined references will prove of interest.[1] The escarpment of Calciferous rises abruptly from the plain of Utica slate to the east and forms a very marked feature of the topography. It is the anticline however which specially brings the ancient crystallines into view along the river. A cross-section is given by Beecher and Hall, which is in part reprinted in Darton's second paper.

Our attention has been specially directed to the characters presented by the old crystallines. Beecher and Hall describe them as follows in their detailed section (p. 10). The Calciferous, 1) rests on a breccia 2) containing Potsdam sandstone, crystalline limestone, quartzite, etc. Next follows ferruginous and chloritic material 3), affording traces of gold and silver and regarded as decomposition products from the gneiss, increased by some sedimentation. Lenticular masses of clay and chloritic matter, likewise containing traces of gold and silver, belong to this layer. Then follows decomposed gneiss 4), and ferruginous labradorite 5), and labradorite 6).

Mr Hill has visited the locality twice and has gathered a com-

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[1] Vanuxem, Lardner. Geology of the third district of New York. 1842. p. 203.

Beecher, C. E., & Hall, C. E. 5th an. rep't N. Y. state geologist. 1886–89.

Darton, N. H. Geology of the Mohawk valley in Herkimer, Fulton, Montgomery and Saratoga counties. 13th an. rep't N. Y. state geologist. 1893. p. 415, and pl. 8.

——— Preliminary description of the faulted region of Herkimer, Fulton, Montgomery and Saratoga counties. 16th an. rep't N. Y. state geologist. 1896. p. 43.

plete series of specimens illustrating the gneiss. Nos. 1 to 5 inclusive were obtained in the eastern cut of the West Shore railroad at the Little Nose, and no. 6 came from the gneiss above the wagon road at the same point. The gneiss strikes parallel with the escarpment, viz, n 25-35 e magnetic, and dips conformably with the paleozoics. A quarter of a mile west the railway runs through a cut in the gneiss about 200 yards long. Nos. 7, 8 and 9 were obtained in the cut. A half mile farther west, as shown by the third colored area, on the south bank of the Mohawk, (*see* pl. 9) the gneiss appears again, and from it nos. 10, 11, 12, and 13 were obtained. At this point the gneiss does not reach as high an altitude above the river as on the east, and it then dips down and disappears.

If one now crosses to the north side of the river and proceeds eastward, the gneiss first appears where the colored area begins on pl. 9, and attains a hight of about 75 feet above the water, rising even higher to the eastward. Specimens 14, 15 and 16 were obtained at this point. Little variation can be noted in the rock. To the east of the "Nose" and the bend of the river there is a large gravel pit of the New York Central railroad. Near the head of the pit is the last outcrop of the gneiss (no. 17) in this immediate vicinity. A heavy talus then covers the gneiss for a long distance around the foot of the escarpment, but it reappears in the town to the north.

Great interest was felt by us in the petrographic characters of this gneiss, the more because Beecher and Hall had named their lowest outcrops labradorite, and it was inferred that the anorthosites might outcrop at this remote southern point. Microscopic sections were therefore prepared of nos. 2, 4, 5, 6, 10, 11, 13 and 17, which were selected to represent all the outcrops and all the varieties. The specimens are practically the same rock, except no. 11, which shows some variation. All the others are garnetiferous gneiss, which under the microscope exhibits quite invariably quartz as the most abundant mineral, and reddish brown biotite as a constant associate. Plagioclase in minor amount is commonly present, and in no. 4, there is a little micro-

perthite. Light red garnets form a very important and a constant component. No. 10 has a nest of little sillimanite needles, contained in quartz. No. 11 differs from the other specimens in being a more basic rock and one that lacks quartz almost entirely. It is no longer fresh but now presents an aggregate of more or less kaolinized plagioclase and chlorite, the latter of which probably represents original hornblende. Biotite is present in considerable amount and is relatively unaltered. A few garnets, apatites and titaniferous magnetite complete the mineralogy. The rock is one that is not at all uncommon among the gneisses of the Adirondacks and probably merely indicates a hornblendic band.

The general character of these gneisses is not different from many that are widespread in the areas farther north and that are probably sedimentary in their origin. It must be stated that there are no labradorite rocks or evident eruptives at the locality.

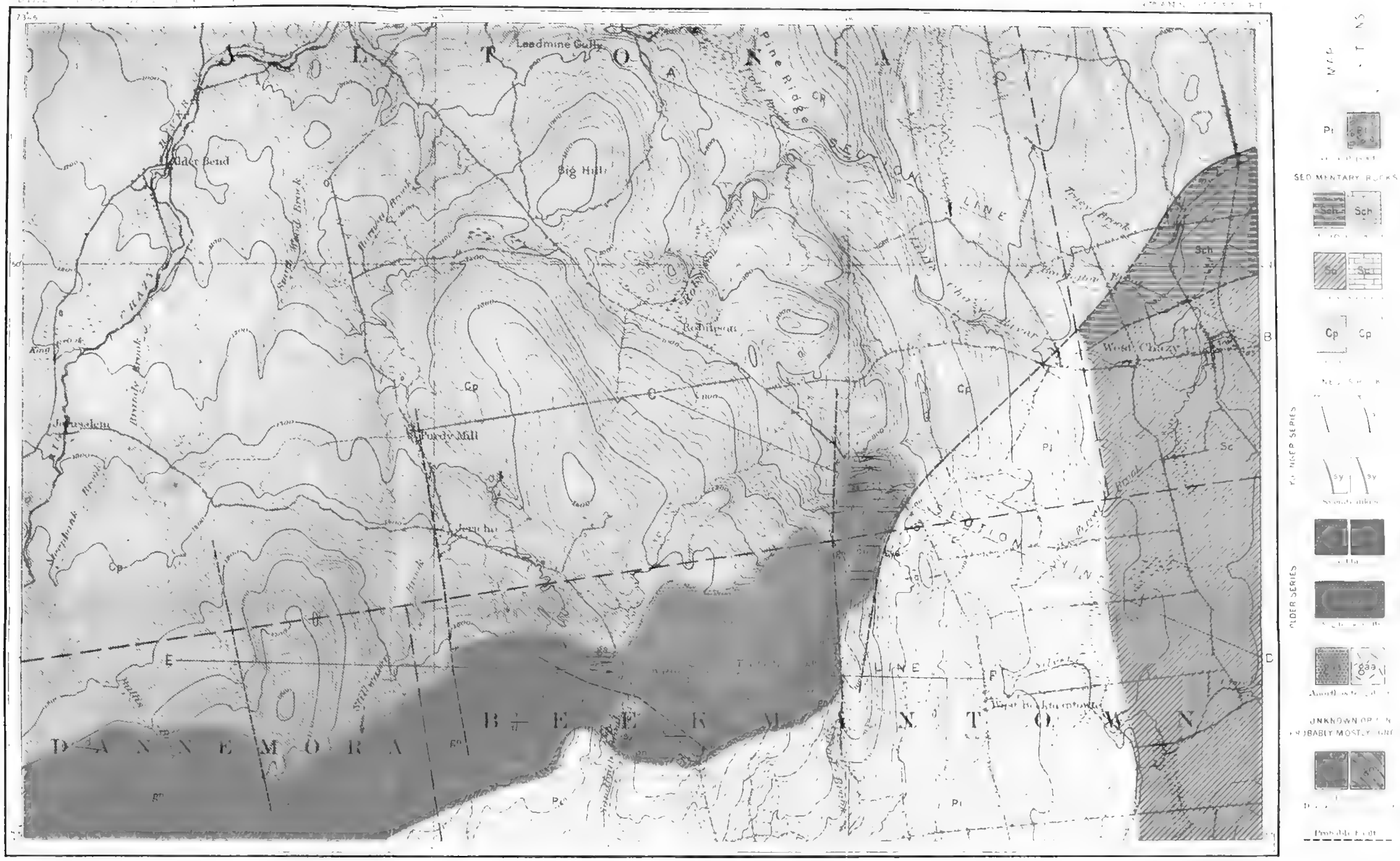
GEOLOGY OF RAND HILL AND VICINITY CLINTON CO.

The area comprised in the Mooers atlas sheet

BY

H. P. CUSHING

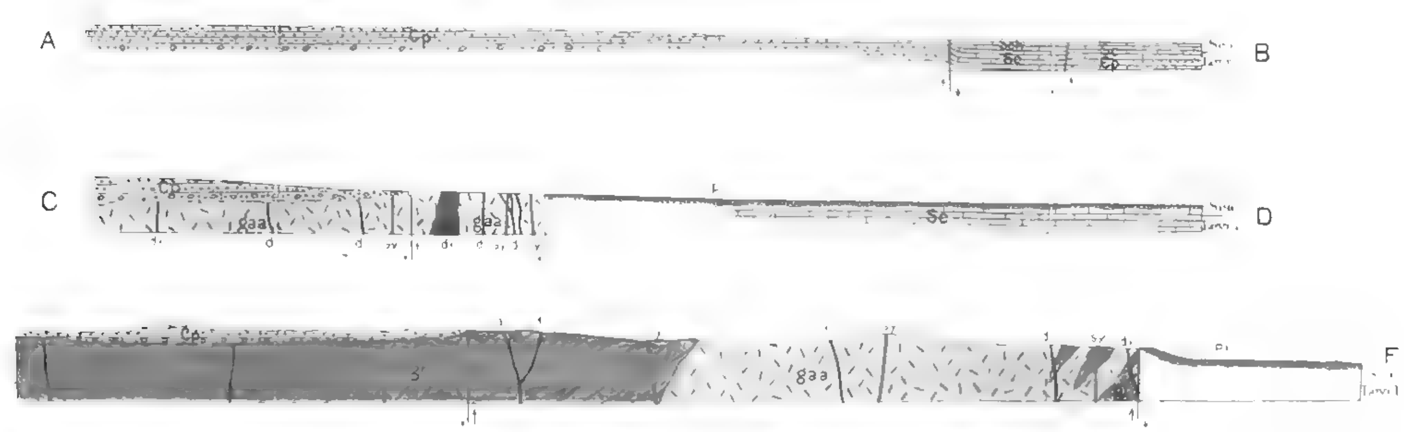
CONTENTS



GEOLOGICAL MAP OF PART OF CLINTON COUNTY BY H.P. CUSHING, 1899

Contour interval 20 feet
Datum is mean sea level

SECTIONS



GEOLOGY OF RAND HILL AND VICINITY CLINTON CO.

Geography

The Mooers topographic sheet covers that part of Clinton county between longitude 73° 30′ and 73° 45′ and between latitude 44° 45′ and the Canadian line. It comprises a considerable part of Altona and Mooers, as well as portions of Beekmantown, Champlain, Chazy and Dannemora townships. The included area contains approximately 218 square miles. The larger portion of this area constitutes a part of the great plain which slopes from the northern foothills of the Adirondacks to the St Lawrence river. That part of this plain which lies in Clinton county slopes to the northeast, that in Franklin and St Lawrence counties to the northwest, away from a north and south axis of elevation along the west edge of Clinton county.

Along the eastern border of the sheet there is a rapid drop, step-fashion, from the level of this plain to that of the much lower plain of the Champlain valley. As the former slopes considerably, the latter but slightly, toward the north, the distinction between the two plains fades out in the northeastern corner of the sheet.

In Dannemora and Beekmantown the foothill belt of the Adirondacks rises above the level of the plain, a series of ridges and valleys in which the hilltops reach all sorts of altitudes and the ridges trend in various directions, and which sinks beneath, or is overlapped by the rocks of the high plain.

In a broad view then, the surface is a plain sloping from an altitude of 1600 feet in the southwest to only 200 feet in the northeast corner of the sheet, or about 70 feet to the mile. Going to the eastward from the southern limits of the map, the drop to the same level is much more abrupt. The main stream on the sheet, the Big Chazy river, which rises in Chazy lake not far beyond the limits of the sheet, follows in a general way

the slope of the surface. Though it has a steep gradient, it has not occupied its present course sufficiently long to have channeled its valley very deeply, specially as the rocks of its bed are mostly very resistant, and the stream itself above Mooers Forks is of no great size. The sharp turn to the east at the forks is due to a glacial moraine across its course which crowds the North branch into the main stream and nearly does the same thing to the English river.

As is the case with all young streams, (that is, streams which have not been flowing in their present channels sufficiently long to have cut them down to grade, and which are therefore actively engaged in deepening them) the courses of the streams on the sheet consist of a series of slack water reaches interrupted by waterfalls and rapids, the latter marking the position of beds which specially resist erosion, followed down stream by those of less resistance, so that the slope at the junction of the two is accentuated by the more rapid cutting away of the later beds. The slack water reaches above are produced by the cutting away of the less resistant rocks above down to the level of the resistant bed at the brink of the fall. As the various layers of sandstone over which the streams flow do not vary excessively in resistance, these features are not as pronounced as they would be, were the variation greater and the different beds thicker. Instead of high falls and long reaches, the falls are frequent and of no great magnitude.

The irregularity of surface of the plain is due in large part to stream erosion, but also in considerable part to displacement. The drop from the high plain to the Champlain valley plain is also along a line of displacement. The surface has been much modified by glacial action, and is less diversified and less thoroughly drained than before the glacial period.

The larger part of the area of the sheet was originally densely forested with white pine on the sandy flats and with spruce and hard wood elsewhere. The pine was long since cut away, and the spruce and hard wood in large part lumbered. Some still remains which will likely go the way of the rest within the next

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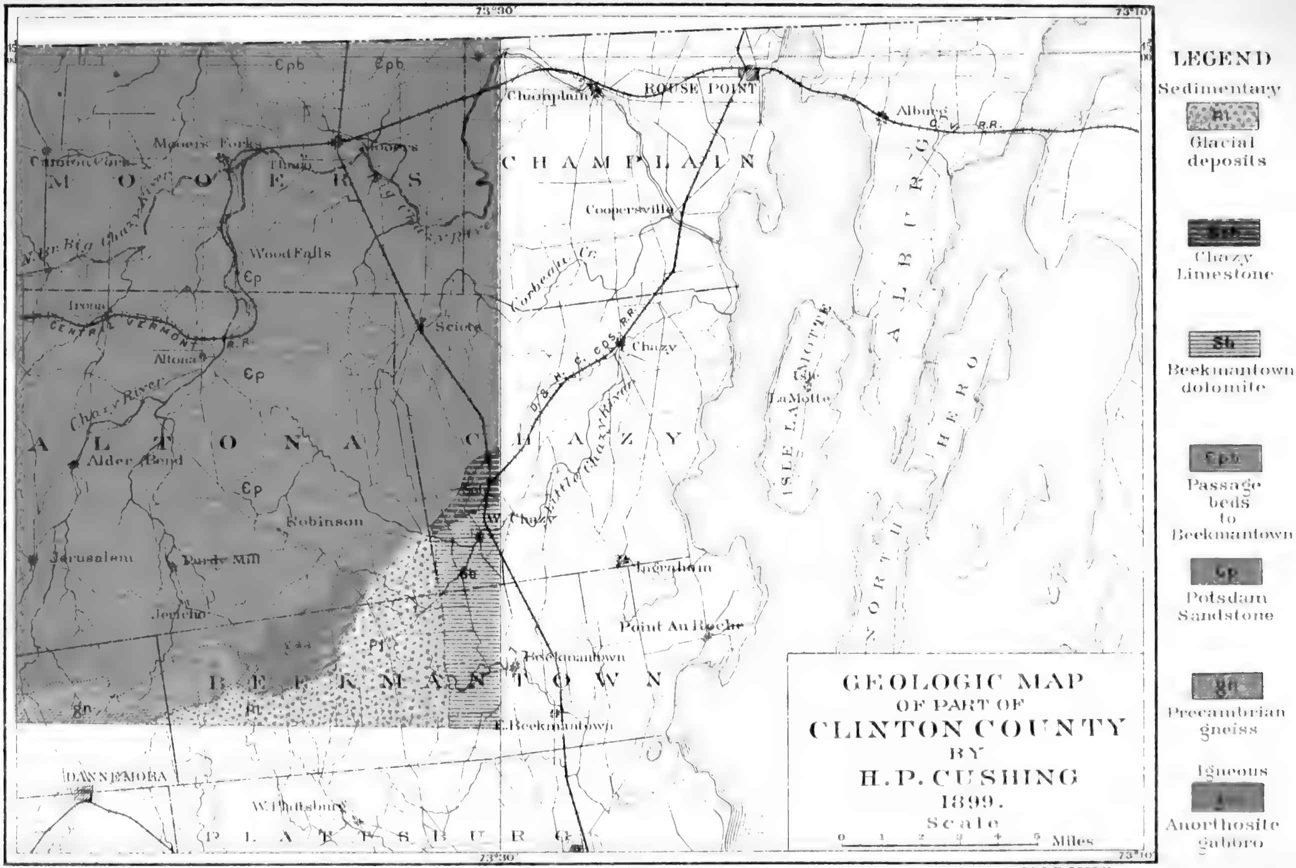

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few years. Fire has usually followed the ax, and old "burns" cover a considerable part of the district, often being almost impenetrable. Birch and poplar spring up to take the place of the more valuable woods.

The bare ledges of sandstone in Altona and elsewhere, known locally as "Flat rocks", are covered with a profusion of blueberry bushes, and the berries are picked in great quantity for shipment in the summer. There is comparatively little good agricultural land on the sheet, the greater part of the surface being sandy, marshy or of bare rock. From West Chazy southward, on the limestones, is the best farming land. Considerable farming is also done in the north of Mooers on the heavy moraine there.

Summary of geologic history

The oldest rocks within the area of the sheet, exposed on Rand hill and thence westward, are among the oldest rocks of which we have knowledge anywhere on the earth's surface. Similar rocks are at the surface throughout the Adirondack region, but they are so old and so changed from their original condition that it is an exceedingly difficult matter to decipher the history which they record. They are in part of unquestionable igneous origin, and have reached their present position by coming up from below in a molten condition and then slowly solidifying. In part they are believed to be old, water-deposited rocks, ancient sheets of sand, mud and calcareous mud laid down on the bottom of some large body of water, in all probability the sea. These are now so greatly changed from their original condition that the structures characteristic of rocks so formed have been almost or entirely destroyed and replaced by others which are not distinctive since they may be produced in igneous rocks as well. The inference as to their original condition is based for the most part on their composition. In third part they comprise rocks which have the thoroughly crystalline character and foliated structure of the rocks of the second group, but whose composition does not suggest that they are of sedimentary origin; they may be

either changed sedimentary or igneous rocks, but are regarded somewhat doubtfully as being of igneous origin.[1]

None of the old water-deposited rocks occur within the limits of the sheet, the oldest rocks found being gneisses of uncertain origin, in Dannemora and Beekmantown. After their formation and when they were essentially in their present condition the mass of igneous rock now constituting the gabbro mass of Rand hill was intruded into them from below. At the time of this intrusion the rocks now at the surface were at a depth of at least 5 miles, that is they had at least that thickness of rocks above them, and the igneous rock solidified at that depth. At some time after solidification all the rocks were subjected to great compression, and the massive igneous rock was converted into a gneissoid rock. A long period of erosion followed, hence the region must have been above sea level at this time. The result of this slow but long-continued wearing away of the surface was to decrease the depth at which the present surface rocks lay buried. Another period of deformation followed and the rocks were fissured, sheared and probably faulted, the difference in the character of the deformation being due to the fact that the rocks were less deeply buried and hence under less load than during the previous deformation period.[2] The main set of fissures so produced had an east and west trend and a nearly or quite vertical inclination. During or closely following this period igneous rock again worked its way up from below, following these east and west fissures. Whether any of this molten rock ever reached the surface or not can not now be told, as no

[1]Crystalline rocks in which there is a more or less parallel arrangement of the constituent minerals, due to which there is a tendency to split or cleave in one direction into more or less even slabs or layers, are said to have a foliated structure. The splitting is usually due to the presence and parallel arrangement of some cleavable mineral such as mica. The foliation is better and more even in schists than in gneisses.

[2]At a sufficiently great depth below the surface the pressure due to the weight of the rocks above is so great that the formation of cracks or cavities is impossible. The necessary depth varies with the kind of rock, but at 5 or 6 miles all fracturing is impossible, that is the formation of open fractures. Hence the character of the effects produced by deformation is an indication of the depth at the time of deformation.

vestige of that old surface now remains. The old lava-filled channels of ascent however are still to be seen, and to such the term "dikes", is applied. There are two sets of these, corresponding to at least two separate periods of intrusion. The lava of the first was fairly acid and gave rise to the red, syenite dikes which are quite numerous on Rand hill, while that of the second was very basic and the source of the black, diabase dikes so common throughout the region.

Another long period of erosion followed, the region still continuing above sea level, and many hundreds of feet of rock were worn away from the surface. Then a slow depression of the district commenced and continued sufficiently long to submerge probably the entire Adirondack tract beneath the waves of the sea. The surface of the sinking land was much more even than it is at the present day, though it still had considerable relief. The stream valleys were well marked and separate by low, rounded hills or ridges. During the long continued erosion period the land must have suffered repeated uplifting in order to permit the removal of so great a thickness from the surface.

During the first part of the period of subsidence the sea was shallow over the land, and sheets of coarse sand, with much gravel, specially at the base, were laid down. Then, either because more rapid subsidence deepened the sea, or else because the land was so lowered and submerged that it was incapable of furnishing more detritus, the waters gradually cleared, and the various limestones, Calciferous, Chazy and Trenton, were laid down in the order named as calcareous muds on the still subsiding sea floor. During the earliest part of this period occasional sheets of sand were swept in by currents and alternate with the calcareous layers. During the deposition of the Trenton limestone currents washed in a certain amount of fine mud from time to time, from some land area probably to the northeast. This increased in amount, in consequence probably of shallowing and the nearer approach of some land area, and the calcareous muds of the Cumberland head rocks and the black muds of the Utica slate were laid down on top of the limestones.

Whether the Lorraine shales, which overlie the Utica slate in the Mohawk valley, were ever deposited in the Champlain valley is a question which can not at present be answered. If so, no trace of them has yet been found.

Be that as it may, the downward movement which had been in progress so long, ceased after the laying down of the Utica or else of the Lorraine shales, and was succeeded by a movement in the contrary direction which carried the whole district above sea level, where it has, for the most part, remained ever since.

Either this upward movement was accompanied by, and likely caused, by deformation; or else deformation ensued not long after the uplift. The effect was greatest in Vermont, and the result there was the uplifting of the Green mountain range the rocks there being considerably folded as well as faulted. In New York only a slight amount of folding was produced, but extensive faulting took place.[1] Some of these faults are easily detected and, moreover, are of considerable magnitude. The Tracy brook fault, for example, has a maximum throw of close to 2000 feet. It is not meant to imply that there was ever that difference in level at the surface on the opposite sides of the fault plane. Such movements are in general so slow that the more rapid erosion on the rising side of the fault may lower its level very materially while the movement is still in progress. There is evidence also of repeated movement, along some of the faults at least, down to comparatively recent times, if indeed such movement is not still continuing.

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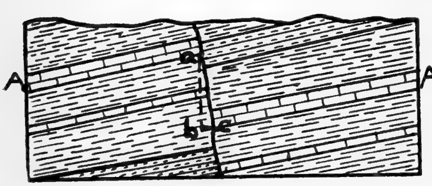
[1]A fault is produced by a sliding movement of the rocks on opposite sides of a fissure, with the result that the same rock stratum is higher on one side than on the other, as illustrated in the accompanying diagram. The stratum AA has been dropped on the right side of the fault relative to its position on the left side. The distance *ac*, measured along the fault plane, is called its *displacement*, the vertical distance *ab*, that separates the two ends of the stratum, is called the *throw*, and the horizontal distance *bc* is the *heave* of the fault.



During or shortly after this deformation period occurred the last outbreak of igneous activity in the vicinity, molten rock again rising from below through the set of east and west fissures. If any of this material ever reached the surface, all trace of it has been worn away, and we see at the present time only the dikes, as the old fissures are called through which the rock worked its way upward and in which it cooled as the activity ceased, filling them solidly from side to side. The Adirondack region was not a center of the igneous activity of this period but on the border, the dikes of this age occurring along the shores of Lake Champlain but not extending back from it for any considerable distance. No dikes of this period have been discovered within the limits of the Mooers sheet, though they are found along the lake shore in the territory covered by the Plattsburg sheet, next southeast. As in the preceding time of igneous rock formation, there were at least two separate periods of activity, the rock of the one being a light colored, acid rock, and of the other a black, basic rock. There are constant differences between these rocks and the preceding diabase and syenite, such that where both occur they may be distinguished. The acid rock followed, instead of preceding the basic, as in the earlier period. With this outburst igneous activity in the region terminated.

There is a possibility that during late Upper Silurian or early Devonian time the region was again depressed below sea level for a short time, at least that the Champlain valley was. The valley came into being as a topographic feature with the faulting of the previous deformation period. There is evidence that the St Lawrence valley at Montreal was below sea level at the time specified, and it is simply inferred that the Champlain valley may have been also affected. If so, every vestige of the deposit laid down on that sea floor has since been eroded away. With the exception of this possible short time of depression the district was a land area throughout the entire vast interval from the close of Lower Silurian time to the comparatively recent departure of the Pleistocene ice sheet. This interval certainly represents at least three fourths of the entire elapsed time since the beginning of de-

position of the Potsdam sandstone, quite likely considerably more. Its duration was certainly several, quite likely many million years. Few parts of the earth's surface have been continuously above sea level for so long an interval.

During this enormous length of time this surface has been subjected to continuous wear. Its history is to be read in the removal, not in the deposition of rocks. From this standpoint a sharp contrast is to be noted between the Champlain valley on the one hand and the Adirondack highlands on the other. The Trenton limestone and the Utica slate are still found here and there in the valley. In such places no great amount of erosion can have taken place. Compared with the other rocks of the region these are the least resistant of all, and their presence forces the conclusion that the Champlain valley was early outlined as a valley and must have remained pretty persistently at a comparatively low altitude. The Paleozoic rocks have suffered more or less considerable erosion on the upthrown side of fault blocks, but the loss has been very small from the downthrow blocks.

On the Adirondack highlands, on the other hand, the entire cover of Paleozoic rocks has been worn away from the surface, except for an occasional insignificant patch on the outskirts. This implies the removal of not less than 2000 feet thickness of such rocks from the whole surface, and more likely double that amount. An unknown amount, probably not excessive, has also been worn away from the surface of the underlying rocks.

It must not be supposed that this necessarily implies that the district ever had an altitude much greater than the present. It seems to have been an uneasy region with frequent small movements of uplift. If long periods of quiescence had intervened, they would have assuredly left their mark in the shape of well defined old base levels of erosion, but such are not to be discovered. Comparatively recent uplift is, furthermore, indicated by the plainly marked character of the north and south axis of uplift along the west edge of Clinton county, and thence southward, as a topographic feature. The faults have served as lines along which frequent displacement has taken place.

In comparatively recent times, so recent that the deposits formed have suffered but little erosion, the region was covered by the Labrador ice sheet. Shortly before the oncoming of the ice it stood at a considerably higher level than the present. The retreat of the ice left the surface mantled with glacial deposits, laid down to greatest depth in the old valleys, so that the surface was more even than before. During the long time that the ice sheet covered the region a slow subsidence was going on, with the result that the retreat of the ice found the altitude some 600 feet below the present, a depression of sufficient amount to permit an arm of the sea to extend up the St Lawrence and Champlain valleys on the disappearance of the ice barrier. The sands and clays deposited there are found at present running up to the 400 foot line and possibly higher. They contain shells of the mollusks which lived in the cold waters and which are of the same species as living forms, some of which are yet found in the Gulf of St Lawrence, while others are confined to colder, arctic waters.

Besides these marine levels there are standing water levels at higher elevations in the valleys opening into the Champlain valley; and these waters must have been fresh, have preceded the salt water incursion, and have been held up at those levels by an ice tongue which lingered in the Champlain valley after the ice had completely melted away from the adjoining highlands, because of its original much greater thickness there.

Since the departure of the ice sheet the region has been slowly uplifted to its present hight. The marine shore lines along the lake are no longer level but rise slowly toward the north, showing that they have been tilted since they were formed, and hence that the uplift was greatest in that direction. The elapsed time since the ice sheet disappeared is so slight that erosion has modified the surface only in slight degree. The deposits formed by the glacier and in the bodies of standing water which followed are substantially as they were left by them.

Dannemora formation

Of the three classes of pre-Cambrian rocks which have been mentioned, the distinctly sedimentary rocks appear nowhere

within the limits of the sheet, nor are any known within the immediately surrounding territory. The prevailing rocks over a large part of the northern Adirondack foothill region are gneisses of doubtful, though for the most part probably of igneous origin, which are distinctly older than the unmistakably igneous rocks. Such rocks are at the surface in the territory comprised in the southwestern part of the sheet. The term, Dannemora formation, is suggested as a convenient one to apply to these widespread rocks on the north, in our present state of ignorance concerning their age and relationships, as they are well exposed all over the mass of Dannemora mountain as well as throughout Dannemora township. The problem of their age, and their relationship to the undoubted sedimentary rocks, is by far the most important unsolved stratigraphic question in the district. Most unfortunately there is practically no opportunity afforded for its settlement, since in the region where the Dannemora formation prevails the other rocks are wellnigh absent, and no contracts where these relations might be shown and studied, are exposed. Nearly all the exposures of the sedimentary rocks in Clinton and Franklin counties are surrounded by the later eruptive rocks instead of the Dannemora formation. Whether therefore the Dannemora rocks are older, younger, or of the same age as the sedimentary (Grenville) rocks does not appear, and the evidence must be forthcoming elsewhere, probably from the western Adirondacks.[1]

[1] Every geologist who has visited the Adirondack region has remarked on the great similarity, if it be not identity, of the pre-Cambrian rocks to the Canadian rocks to the northward. This is specially true of the igneous rocks and those of sedimentary origin (long ago named the Grenville series by Logan). There is also there a supposedly older series of gneisses known as the Ottawa gneiss. The term, Ottawa gneiss, is not used in this report simply because it is not yet determined whether the Dannemora gneiss is the representative of the Ottawa gneiss in the Adirondacks, or whether it represents rocks which are classed with the Grenville series in Canada, or whether it represents neither. The term, Grenville, *is* used for the sedimentary series because the similarity between these rocks in the two districts has been noted by every observer who has gone into the field, and it is exceedingly probable that they were deposited in the same basin. Smyth has suggested the name, Oswegatchie series, for these rocks in the western Adirondacks, on the ground that their similarity with the Canadian rocks does not neces-

The rocks of the Dannemora formation are quite varied and yet quite uniform. Nearly every outcrop shows two or more varieties of gneiss interbanded with one another. The rocks also differ much in coarseness or fineness of grain from place to place. Yet there are practically only four varieties of gneiss in the district, which however grade into one another through intermediate varieties.

The two most abundant kinds of gneiss in the vicinity are a finely granular red gneiss which has the composition of a granite, that is, made up of quartz and microperthitic feldspar with additional small amounts of either hornblende or biotite or (more rarely) augite, and magnetite; and a black, more gneissoid rock with the essential make-up of a diorite, that is, composed of hornblende and a feldspar ranging from oligoclase to labradorite in composition, with magnetite and either biotite or augite in addition. With these are occasional streaks of a gray gneiss composed of biotite, hornblende and an acid plagioclase feldspar, quartz being mostly lacking; and gray to red, evenly granular rocks of quartz, orthoclase feldspar and abundant pyroxene which are often called pyroxene granulites. All these gneisses are cut by a later coarse, red granite or granitoid gneiss, which occurs either in small masses cutting across the foliation of the gneiss, or else more intricately cutting it in thin films and sheets which are in general parallel to its foliation.

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sarily show equivalence in time. This term has priority for the Adirondack rocks if a new name is to be used. But no one can now show whether the rocks of the two areas are, or are not, equivalent, nor is any one likely to be able to do so in the near future. No one has any idea of the thickness of either series, nor even how many beds of limestone there are. There may be just as great a difference between the eastern and western Adirondack rocks in age as between either and the Canadian. There must be a great difference in age between the top and bottom of the series. It seems therefore to the writer more logical to use a name which brings out a universally observed relationship, rather than to inject into an already overburdened literature a new term, based on what is at present a wholly gratuitous supposition. In these old rocks in which fossils are lacking, it is impossible to apply the same fine discriminations as in the fossiliferous rocks, and it would seem to be time enough to apply a new name when non-equivalence is shown to be something more than a mere possibility.

This complex of gneiss and granite makes up the mass of Dannemora mountain and forms the hills in Dannemora and Beekmantown in the southwest corner of the Mooers sheet.

As has been stated in previous reports, if there is any formation in the northern Adirondack region which is the equivalent of the Ottawa gneiss of Canada, or which may be of Archaean age in the restricted sense in which that term is now employed by the United States geological survey, it is this Dannemora formation. Unfortunately in the district in Clinton and Franklin counties in which it prevails, the Grenville series is practically absent, and a rather careful survey of the area has failed to disclose any exposures which throw any light on the question. The problem is much complicated by the intimate association of very similar gneisses with the undoubted Grenville rocks in the western Adirondacks, where, if anywhere, there is a prospect of settling this question.

On Rand hill, specially at its eastern edge, is considerable gneiss which is cut through and through by the gabbro, with unmistakable irruptive contacts, showing that the gneiss is the older rock.[1] The gneiss that appears on the west side of the hill is mainly of the black dioritic variety, though there is much of the red gneiss also. It seems totally unaffected by the gabbro, and there is thought to be a fault between, though the evidence of this is not decisive. On the east the gneiss is best shown along the cliff face and along Mead brook. Here it is all cut up by the gabbro and differs quite materially in character from that on the west. Nowhere else in the Adirondack region has the writer seen such contacts, nor has he met elsewhere a gneiss precisely similar to this.

It is for the most part a well foliated, black and red or black and gray gneiss, quite like some intermediate varieties of the ordinary gneiss. But often, specially near the gabbro contact, it is hard and flinty and breaks with a conchoidal fracture. In

[1]Rand hill, as here used, applies to the whole area on which the gabbro outcrops, the low north end as well as the summit; locally it is usually restricted to the latter.

composition it is either a quartz-orthoclase-hornblende, or quartz-orthoclase-augite rock.

Under the microscope the same indefinite, granular structure is shown which the ordinary gneiss possesses, except that near the gabbro there are also corrosion zone (reaction rim) structures quite like those in the gabbro itself. Along Mead brook are a series of most excellent exposures of rapidly alternating gneiss and gabbro, the latter cutting across the foliation of and sending dikes into the former. This gneiss is essentially made up of orthoclase, hornblende and quartz, with accessory zircon, apatite, pyrite, magnetite, garnet and biotite. The magnetite is nearly always surrounded by hornblende. The hornblende is patchy, very irregularly bounded, and full of small biotite shreds which seem secondary; commonly also the magnetite and hornblende are separated by a narrow zone of biotite, consisting of closely packed, very minute shreds. Considerable garnet has formed in places at the contact between hornblende and feldspar, accompanied by small grains of secondary quartz. Precisely similar corrosion zones are found in the gabbro near the contact. The garnet zones are found all through the gabbro, but the biotite zones have not been noted except near the contact, though they may occur. The writer is disposed to explain the facts by the assumption that the gneisses on the east and the west side of the hill are the same, and that the differences noted on the east side are due to contact metamorphism, with the production of a narrow zone of mixed composition between the two rocks, due to incorporation in the gabbro of material from the gneiss.

The augite gneiss from the same locality is an even more flinty rock, and in it garnet has been largely developed at the contacts between both magnetite and augite, and feldspar. This would imply that the feldspar is plagioclase, though it is largely untwinned. In the ordinary Dannemora gneiss garnet is a rare mineral, though abundant in the Grenville gneisses. No similar rock has been observed on the west side of the hill, and the amount of change produced by the intrusion is a matter of uncertainty.

Gabbro intrusions

There are two main varieties of gabbroic rocks exposed in the district: the one the coarse grained, blue-black rock, weathering white, which forms the main mass of Rand hill; the other a fine-grained, black rock, occurring only in dikes or in small bosses, which cuts and is therefore later than the other—which is, in fact, the youngest of the older Adirondack eruptives. It is one of the most widespread rocks in the whole Adirondacks, though the total bulk is not great. It is usually gneissoid, though often unchanged cores remain, and these have an ophitic structure, that is the feldspars are in well formed, lath-shaped crystals, giving a characteristic appearance to the rock. It belongs to the gabbro variety known as hyperite, and has been frequently described in detail, of late, by the different workers in the region, so that no extended description is called for here. The gneissoid phase is readily distinguished from the older, hornblende gneisses by the usual dike-like form, finer grain, poorer foliation and general more firm and resistant character.

The first variety is merely a phase of an igneous rock which has a wide extent in Essex and Franklin counties and whose nearest outcrops are on Halleck hill north of Keeseville. The Rand hill rock is peculiar and unlike any heretofore described from the Adirondack region. While the ordinary Adirondack rock is related to the gabbros, it is of a special and peculiar type to which the name, anorthosite, has been applied. The Rand hill rock is of an intermediate type which may be distinguished by calling it anorthosite-gabbro.

Anorthosite-gabbro

Anorthosite is a deep-seated igneous rock composed essentially of labradorite (or some allied feldspar) with accessory augite, hypersthene and titaniferous magnetite (or ilmenite), the total amount of all these being but slight. Gabbro is a similar rock of augite (or hypersthene) and labradorite in an approximation to equal quantity. Anorthosite-gabbro, while predominantly feldspathic, has the other minerals in sufficient quantity to make

it necessary that they be considered essential constituents of the rock rather than mere accessories.

The Adirondack anorthosites were originally very coarse grained rocks, the individual crystals of labradorite often attaining a length of three inches or more. The deformation which they suffered while deeply buried, more or less broke up these large crystals into a mass of granular fragments, with the result that the rocks as now exposed consist partly of the unbroken portions of the original crystals and partly of the granular material, sometimes the one and sometimes the other predominating, though usually the latter. They were also somewhat foliated, specially at the borders of the mass, where there is a frequent passage into a well foliated gneiss in which little or no trace of the original structure remains.

The Rand hill rock is much more thoroughly granulated than the usual anorthosite and was, most probably, originally a finer grained rock. In the southerly exposures the granulation is practically complete, and no labradorite *augen* (a convenient term for the uncrushed parts of crystals) remain. It is only in the northerly exposures that such are found, and even there the bulk of the rock is granulated. Many augen however remain, running up to an inch in size, though seldom exceeding that figure. As in general the border portions of these intrusions are the most crushed, it is not probable that we are here dealing with the limit of the mass in this direction, it in all likelihood continuing to the northward under cover of the Potsdam sandstone.

Since the Rand hill rock contains a larger amount of minerals other than feldspar, than does the usual anorthosite, it was more definitely foliated by deformation, and much of the rock exposed is thoroughly gneissoid. As a whole however it strongly resembles some of the border phases of the larger intrusions.

The most important difference between this rock and anorthosite consists in the constant presence in considerable amount of quartz; so that strictly it should be called a quartz-anorthosite-gabbro. The rock is of somewhat unusual type, has not been heretofore described from the region, and is therefore deserving of

minute description. Unfortunately it has not been investigated chemically.

Mineral content

The primary minerals (those formed by the original cooling of the rock) which have been noted in the Rand hill gabbro are as follows, in relative order of abundance: plagioclase feldspar (usually labradorite), augite, quartz, hornblende, hypersthene, apatite, ilmenite (or titaniferous magnetite), zircon, pyrite, pyrrhotite and titanite. Secondary minerals are garnet, hornblende, biotite and quartz. There are a number of other minerals present which have resulted from the excessive alteration or decomposition of the foregoing, but they are the usual ones and do not need farther mention. The order of crystallization was the usual one, first the zircon and apatite, followed by the iron ores, then the hypersthene, augite and hornblende, whose relative order is not apparent, next the feldspar and last of all the quartz. The periods of formation of the dark silicates and of the feldspar largely overlap.

The feldspar is in all respects like that of the anorthosites. It is full of inclusions of uncertain nature, mostly of short, stout, opaque rods. It is usually a well twinned plagioclase, albite twinning being well nigh universal, that after the pericline law often combined with it, but Carlsbad twinning being very exceptional. Sections cut perpendicularly to the twinning plane show maximum extinctions of from 20° to 24° in all the slides. This makes it reasonably certain that no feldspar more basic than labradorite is present, though not precluding the possibility of a more acid one being at hand in slight amount. Five cleavage pieces (parallel to the M cleavage) from different augen give extinctions of from —15° to —17° from the edge of the P cleavage, with an average of —16°, which is precisely the angle of typical labradorite, $Ab_1\ An_1$.

Of the pyroxenes hypersthene is relatively rare, a light green, non-pleochroic augite being the usual mineral. This is identical with the usual augite of the anorthosites and has been often described.

While there is unquestionably some primary hornblende in this rock, much of this mineral is secondary after augite, and most of the rock is not sufficiently fresh to permit a good judgment as to the relative proportions of the two. When the respective amounts of hornblende and augite are compared, much variation is found, and some of the rock would be more properly described as a diorite, rather than a gabbro. In general the augite preponderates, and the close relationship between these rocks and the anorthosites is so evident that the general application of the term, gabbro, to the whole is perfectly justifiable.

The ilmenite (or titaniferous magnetite) and the zircon are quite as in the anorthosite. Occasional crystals of the latter are of sufficient size to be visible with a hand lens.

Pyrite and pyrrhotite are not as abundant as in many parts of the anorthosite, but both are sparingly present.

The great abundance of apatite in much of the rock is one of its unusual features. In addition to the usual minute, slender crystals is much coarser apatite in irregular grains, often concentrated in little streaks which run clear across a slide. It is very irregularly distributed, but at a rough estimate there is from 3% to 5% in the rock as a whole, and several of the slides show from 5% to 10%.

As has been stated, this rock underwent deformation while deeply buried. The individual crystals were strained, bent, broken and more or less completely granulated, with considerable recrystallization accompanying the process. That much of the granular feldspar has been recrystallized is indicated by the fact that much of it does not contain the minute inclusions which are so characteristic a feature of the original feldspar. In part also the granular feldspar is untwinned, and such individuals usually show irregular, patchy intergrowths of two different feldspars. This has not been carefully investigated, but such intergrowths are also found in some undoubted labradorites, and Becke's method indicates little or no difference in refractive power between the two feldspars.

The main difference in mineralogic make-up of the rock resulting from deformation is the production of abundant garnet. This is usually a dark red garnet (probably a lime-alumina-iron garnet) which occurs either as well formed crystals or as rims around the magnetite (ilmenite). It occurs between labradorite and magnetite, less often between augite or hornblende and labradorite, and never away from the feldspar. The material of which it is composed has been derived from the adjacent minerals, particle by particle, the garnet forming at their expense. As it is a more basic mineral than the labradorite, an excess of silica is left, which has crystallized out as quartz, partly inclosed in and partly bordering the garnet. What has become of the soda of the feldspar is an interesting question. It would seem that albite should have formed, but it has not been detected.

It is not easy to account for the fact that garnet has not been produced between magnetite and feldspar in all cases, but there are quite numerous instances of magnetite wholly surrounded by feldspars, or partly inclosed by them, in which there is no trace of garnet formation. Evidently some accessory to the process was present in the one case and absent in the other. It does not seem to have been water, since around some such magnetites the feldspar is thoroughly granulated and has apparently been largely recrystallized, implying the presence of water. The development may have been confined to the cleavage planes, and unquestionably is mainly in them.

In those parts of the rock in which garnet is scarce or lacking the magnetite is always completely inclosed by pyroxene and hornblende. To a certain extent such hornblende seems to have resulted from interaction of the magnetite and pyroxene.

Between hornblende, or pyroxene, and feldspar garnet is by no means so frequent as in the other association. It is in the more gneissoid varieties of the rock that it is found so associated most abundantly, here being well crystallized and strung out with the dark silicates along the cleavage planes. Here unquestionably much recrystallization has taken place, consequent on the deep-seated deformation, and the garnet formation is to be ascribed

to this period. In the case of the corrosion zones around magnetite there may be some question whether the garnet developed at this time or earlier.

Quartz occurs in the rock associated with garnet, as already noted. But in addition there is much coarser, granular quartz along with the granulated feldspar. None could be found which could be definitely determined to be primary, most, if not all, of it having recrystallized during deformation. On the other hand, it is quite certain that the recrystallization has been nearly in situ, and that in the original rock an equally large amount of quartz was present. Some few large individuals found with large, uncrushed labradorites would seem in all probability primary. A rough estimate of the amount present in the rock would give a range from none to 15% with an average of at least 10%.

A farther indication of the considerable amount of recrystallization which the rock has experienced, is furnished by the occasional presence of quartz inclusions in feldspar and even in hornblende and augite, quite after the fashion of the inclusions in many of the gneisses.

Gabbroic rocks containing quartz have been described from several localities in many parts of the world; hence this occurrence is by no means unique. Yet it is exceptional and important. Notwithstanding the amount of quartz, it is by no means certain that the rock is more acid than the ordinary anorthosite. If from 3% to 5% of alumina was replaced by iron in the ordinary anorthosite magma, an excess of silica which would crystallize out as quartz would result. That this anorthosite-gabbro was derived from the same parent molten mass as produced the anorthosite, is beyond question.

The writer has previously called attention to the great similarity between the eruptive rocks of the Adirondacks and those of the Ekersund-Soggendal district in Norway, recently exhaustively described by Kolderup.[1] This writer describes a quartz-norite as

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[1] Kolderup, C. F. Bergens museums Aarbog. 1896. Die labradorfelse des westlichen Norwegens.

Cushing, H. P. Bul. geol. soc. Amer. 10:190.

occurring in considerable amount there; and the Rand hill rock furnishes still another illustration of the close parallelism of the two series.

An analysis of the anorthosite gabbro from Carne's quarry has been made by Prof. E. W. Morley to whom the writer wishes to express his great indebtedness. This analysis follows together with one of an Adirondack anorthosite and one of an Adirondack gabbro for comparison.

	1	2	3	4
$S_1 O_2$	47.42	51.62	54.62	.8603
$Al^2 O_2$	17.34	24.25	26.5	.2397
$Fe_2 O_3$	4.91	1.65	.76	.0103
FeO	10.22	5.3	.56	.0736
MgO	5.21	1.21	.74	.0302
CaO	8.09	9.97	9.88	.178
$Na_2 O$	3.48	3.49	4.5	.0563
$K_2 O$	1.89	1.27	1.23	.0135
$H_2 O$	1.13	.72	.91	
TiO_2	3.6	undet.		
$P_2 O_5$	.06	"		
Cl	.21	"		
MnO	.06	.1		
BaO	.04	undet.		
Total	100.06	99.78	99.70	
O=Cl	.05	Sp. gr. 2.8		
	100.01			

1 Analysis by E. W. Morley of the least metamorphosed hyperite gabbro that I have met in the Adirondacks, Hopkinton, St Lawrence co.

2 Quartz-anorthosite-gabbro, Carne's quarry, Rand hill, Altona township; analysis by E. W. Morley.

3 Anorthosite, analysis by A. R. Leeds, 13th annual report New York state museum, 1876.

4 Molecular ratios of analysis 2.

From the molecular ratios a rough calculation of the mineral composition of the anorthosite gabbro is readily made, the al-

kalies and a part of the lime being assumed to go into the feldspar, the residue of alumina and lime along with the iron and magnesia forming garnet, augite and hornblende. The result is as follows.

	%		%
Magnetite	2.4	Albite	29.7
Garnet	11.75	Orthoclase	7.5
Augite	11.0	Quartz	5.0
Anorthite	32.0		

This calculation agrees well with the evidence of the thin section as to the composition of the rock except that the latter would indicate a somewhat larger percentage of free quartz. But even 5% of quartz in a rock of this basicity is noteworthy, and some of the rock of the hill is considerably richer in quartz than that analyzed.

A comparison of the three analyses brings out clearly the close relationship of the rock to ordinary anorthosite on the one hand, and its intermediate position between that and gabbro on the other. But as in all gabbroic rocks there is much variation from place to place and unquestionably samples from different portions of the hill exposures would be found to vary widely. It is not thought that any is more basic than that analyzed, but likely much is somewhat more acid. While much of the Rand hill rock is very rich in apatite it is barely present in the rock analyzed.

Augite-syenite

On the east edge of Rand hill, near the top of the cliff, is a small area of a greenish gray, fine grained, rather gneissoid rock in which recently a quarry has been opened. This is classed with rocks quite widespread in the Adirondack region and recently described, though a small degree of doubt remains as to the correctness of the reference.[1] This rock is thoroughly granulated and gneissoid, with much recrystallization, yet, except for its finer grain, it has precisely the same appearance and mineral content as the ordinary augite-syenite as it appears at Loon lake

[1] Cushing, H. P. Bul. geol. soc. Amer. 10:177-93.

or Tupper lake. Its minerals are hornblende, augite, bronzite, feldspars and quartz, with accessory magnetite, apatite and zircon, and garnet also in the outer parts of the mass. The feldspar is mostly anorthoclase, some showing plainly irregular intergrowths of two feldspars, probably orthoclase and albite. Quite a little oligoclase is present in addition. Quartz constitutes some 15% of the rock.

The outcrops of this rock are not extensive, and it clearly is a mass of no great size, extending only a few rods in any direction. On the east, down the hill, the rock appears to be grading into the ordinary gneiss, but no further exposures appear in that direction. In all other directions anorthosite-gabbro or else gneiss is reached at no great distance, but there are absolutely no contacts showing anywhere, so that the field relations of this apparent syenite are left in entire uncertainty. So far as the age of the augite-syenite is known, it is younger than the anorthosite, but that need not necessarily imply that it is younger than this anorthosite-gabbro. This occurrence may be a dike, though that is unlikely, as its extension could not anywhere be found; it may be a small intrusive mass, though it is exceptionally small for a mass of such origin. In the utter absence of field evidence the reference is made simply on the character of the rock.

Later igneous rocks

The much later age of these rocks is inferred from the fact that they are wholly unmetamorphosed, though they have suffered deformation. It is thought that this deformation would have caused metamorphism, had the rocks been buried deeply enough. The inclosing rocks are older and were metamorphosed before these later rocks found their way through them. When metamorphosed, they were deeply buried in the zone of flow, and are now exposed at the surface because all the overlying rock has been eroded away. But the later rocks exposed at the surface have never been in that zone. Much less rock had to be worn away to bring the present exposures to the surface, and hence a long erosion period between the time of

formation of the inclosing rocks and of these later ones is argued. It is thought that the amount of material removed during this time will not fall short of the entire amount which has since been removed, but, even if this be an overestimate, the intervening period must have been long.

As has been already stated, these rocks are found at the present time only in dikes. We see the channels through which the material ascended, but can not tell whether any reached the land surface of that time, nor do we anywhere get a glimpse of the reservoirs which supplied the material, since erosion has not yet cut deeply enough to disclose them. The comparatively small area now occupied by these dikes thus gives little idea of the possible importance of this eruptive period. It seems however improbable that great surface flows should have taken place, else we should surely find remnants of them in protected places. It seems more likely that the forces of eruption were spent in forming intrusive masses from which the dikes radiated upward, dying out above. The dikes plainly owe their existence to the same causes which were responsible for the earlier, great intrusions, and mark the last paroxysm of igneous activity from that source.

The two distinct dike rocks of this period have been already noted. On Rand hill the two are more nearly of equal importance and abundance than in any other spot in the entire Adirondack region, and dikes of both sorts are very numerous. 19 of the red, syenite dikes have been found on the hill, of which seven were noted in a previous report.[1] The black, diabase dikes are even more numerous, but impossible to enumerate, since they are frequently found combined into a great dike plexus of many branches. The display of dikes is the most impressive known in the Adirondacks. It must either signify an intrusive mass not far beneath or else mark the spot whence much material was poured out on the old surface above.

[1] 15th an. rep't of the N. Y. state geol. 1895. p. 562–66. When this report was written these dikes had not been differentiated from the similar, post-Utica dikes along Lake Champlain, and they are therefore spoken of as bostonites.

The wider distribution of these dikes is of interest. The syenite dikes do not range far to the west and south of Rand hill, and so far as present knowledge goes must be counted by tens in the Adirondack region as a whole. But the diabase dikes range farther to the west and far to the south, and there are hundreds of them. It is also of interest, taking a still wider view, to note that igneous activity was widespread over the land areas and shallow sea bottoms to the east and west of the Adirondacks during these very ancient times, and that the Adirondack eruptives are very like those which characterized Keweenawan time in the upper lake region, and probably approach them as nearly in age as they do in character.

These dikes vary in width from an inch or two to forty or fifty feet. Their contacts with the inclosing rocks are exceedingly sharp. Joints, due in large part to shrinkage on cooling, are much more numerous than in most of the adjacent rocks, so that the dike rocks weather out into a multitude of sharply angular, small blocks.

The syenite dikes are usually of some shade of red, ranging toward and passing into a brownish black in some instances. They mostly show rather large, porphyritic feldspars and sometimes black mica as well. The narrow dikes and the margins of the larger ones consist of very fine grained, flinty rock. Their general composition is of magnetite or specular hematite, hornblende, biotite, microperthitic feldspar and quartz, but they vary greatly in acidity and hence in the relative proportions in which these minerals are present. Some of these dikes have been described in considerable detail elsewhere, and those more recently discovered add little that is new.[1]

The diabases are without exception black in color, weathering to yellowish brown along the joint planes, so that the small weathered blocks show simply this color. They vary in grain with size, but all are very fine grained. Nearly all show porphyritic feldspars which in a few dikes are notably large and may reach a length of an inch, but which are usually minute. These

[1] Cushing, H. P. Bul. geol. soc. Amer. 9:239–56.

dikes have been described in considerable detail by Kemp.[1] They vary greatly in structure and mineral content. Practically all are porphyritic, but in the center of the larger dikes the porphyritic structure disappears, and the rock becomes a true diabase; otherwise it is more properly a diabase-porphyry. Olivine is almost always present.

These rocks have almost identically the composition of the hyperite-gabbros, yet no garnet, so abundant in the gabbro, has developed. On the other hand, biotite rims around magnetite, specially at magnetite-feldspar contacts, are a conspicuous feature in the diabase, and occur also in the gabbro. The writer has found no biotite in his freshest diabase dikes, and in those in which it occurs it seems always to be surrounded by more or less altered parts of what may be otherwise quite fresh rocks. Hence a disposition to regard it as secondary instead of primary and also to regard it as produced in a more superficial zone than that in which the garnet develops.

The only rocks with which these diabases are likely to be confused by anyone are some of the narrower dikes of hyperite-gabbro. From any of these they may be easily distinguished by their finer grain, greater variation in grain from center to margin, more flinty character and more excessive jointing.

In only one case has it been possible to make a relative age determination between these two sets of dikes. At the summit of Rand hill, one fourth of a mile east of the house of L. Sanger and on the east side of a knoll of gabbro, a 15 inch dike of the syenite-porphyry, bearing n 65° e, is cut by a dike of diabase of the same width bearing east and west. In this case the diabase is indisputably the younger. While this does not make it safe to say that all diabase is younger than all the syenite, it at least points in that direction.

Paleozoic rocks

Potsdam sandstone. Rocks classed as of Potsdam age are at the surface over the larger part of the Mooers sheet. The rock

[1] Kemp, J. F. Bul. 107 U. S. geol. sur. p. 24–29.

as a whole is of very uniform character, mostly a coarse grit, white or buff in color, lying in quite massive beds which in places weather into flags. Much of the rock is cross-bedded, and the surfaces of many layers are ripple-marked. More or less pebbly layers prevail throughout, though most notably at the base.

The bulk of the formation consists of pretty pure quartz sand. There is considerable variation in thoroughness of induration among the different layers, but the great mass of the rock is not very porous, the interspaces between the quartz grains being very thoroughly filled with secondary silica. Hence but few of the layers are water-bearing.

The thickness of the formation is unknown. The beds are nearly horizontal, the prevailing dip being to the north and seldom reaching 5°, while in the majority of cases it is so slight as to prevent accurate measurement. Dips changing from northeast to northwest indicate the presence of extremely gentle folds. The homogeneous character of the rock makes it impossible to follow individual beds for any distance and also prevents the detection of the faults which are assuredly present. The thickness is unquestionably great, but its determination must await the evidence of the drill, and the recent boring at Morrisonville, the only deep well ever put down in Clinton county, has passed only part way through the formation. The record will appear on a later page, but a thickness of 800 feet of Potsdam has been passed through with no indication of approach to the base of the formation, so that the entire thickness may be double that amount.

The basal beds of the formation differ in character from the main mass, much of the rock becoming coarse and pebbly and some very coarse conglomerates occurring. Red is the prevailing color for the finer grained basal beds, the more strongly colored owing it to secondary deposition of iron oxid (hematite). The basal beds are by no means as purely quartzose as the main mass of the formation, feldspar (mostly red orthoclase) being present in large quantity and in places much magnetite in addi-

tion. This part of the rock is more properly an arkose than a sandstone. As these rocks were formed from the ruins of the pre-Cambrian rocks, their composition indicates much only partially decomposed material on the old land surface, and some of the very coarse conglomerates exhibit very coarse material of this kind, only slightly water-worn, as if protected in an old hollow of the surface.

There is much conglomerate in the basal Potsdam of the Mooers sheet but by no means so coarse, or so extensive, as in many other places. But the basal red beds are more widely exposed than in any other part of the Adirondack region. On the north and west of Rand hill there is much thin-bedded, deep red rock which disintegrates easily, and is interbedded with harder and firmer bands of massive red sandstone. These rocks give rise to a deep red soil by their rapid breaking down. The harder beds furnish an excellent building stone, not so flinty and of a deeper red color than the well known stone from Potsdam. These beds seem to mark the extreme base of the formation in this vicinity. They are so extensive and so different from the usual coarse base of the Potsdam that there has been some question in the writer's mind as to whether they properly belong with it, but, aside from their somewhat different lithologic character, no evidence for or against this view has been forthcoming.

On the west side of Rand hill, surrounded by pre-Cambrian rocks on three sides and with their extent to the southwest hidden by the heavy moraine covering in that direction, are two outliers of these red beds, which gave the writer the idea, in his earlier and more hurried survey, that the Rand hill pre-Cambrian rocks were nearly or quite surrounded by the Potsdam. But diligent search in the woods of western Beekmantown resulted in the discovery of three small exposures of gneiss, sufficiently separated to show clearly the absence of the Potsdam. These outliers are at the same elevation as the corresponding beds farther north, no sign of faulting was discovered, and they are believed to occupy old depressions in the pre-Cambrian surface, as Kemp believes similar outliers in Essex county[1] to do.

[1]Kemp, J. F. Bul. geol. soc. Amer.

In the southeastern corner of the sheet, on the unnamed hill in extreme northeast Dannemora, the Potsdam sandstone is found at the greatest altitude yet noted for that formation in the Adirondack region. This hill was erroneously mapped as gneiss in the report on Clinton county in the *15th annual report of the New York state geologist.* As it is difficult of access, and time could not be taken to visit it, the topography, the altitude, and the statements of guides were taken as the basis of the mapping. But it seems unsafe to infer anything in Adirondack geology. The ground must be gone over foot by foot.

The hill breaks off in a cliff on the west side which looks like a fault scarp. On the north and east at 1600 feet is a broad shelf of bare, nearly horizontal sandstone, which is covered with blueberries and reproduces, on a small scale, the conditions on the Flat rocks in Altona. Rock was found exposed on the hill up to 1700 feet. The top is covered with morainic material but how deeply is uncertain; the Potsdam certainly runs up to something over 1700 feet however. A section of at least 200 feet in thickness is comprised in the hillside. The occurrence of the rock at this elevation is strongly suggestive of its former much greater extent in the region.

Passage beds. Between the Potsdam and the overlying limestones is a zone, some 50 feet in thickness, of rapidly alternating layers of pure white sandstone with all the lithologic characters of the Potsdam, and gray, sandy, dolomitic limestone precisely like the Calciferous above. These beds have been usually classed with the Potsdam. The only exposures of these beds within the limits of the sheet are in the northern part of Mooers township. The geologic map of Canada shows Calciferous coming down to the boundary at this point, but on the New York side of the line there is no Calciferous exposed unless these passage beds are to be counted such.

Calciferous (Beekmantown) limestone.[1] Though rocks of this

[1] Clark & Schuchert. Science. 10:874–78. The term, Beekmantown, is much more suitable than the old name and should supersede it. The type localities are just outside the limits of the sheet.

age are the surface rocks over a considerable tract, they are effectively concealed by heavy drift except at West Chazy, where a thickness of 10 feet of massive, blue-gray dolomite is exposed in the river and a higher layer at the surface in the town. South of West Chazy and east of Rand hill there is not a single exposure of rock within the limits of the map, though plentiful outcrops occur in Beekmantown, just beyond those limits. Some uncertainty therefore prevails as to just what is underneath. It is the writer's opinion that the Calciferous extends all the way to the edge of the Rand hill, being there faulted down against the pre-Cambrian. This opinion is based on the fact that to the south, in Plattsburg, the Calciferous runs as far west as what is taken to be the prolongation of this fault line. But it is by no means impossible that another fault is concealed in this interval, in which case Potsdam would lie between the Caciferous and the pre-Cambrian. On account of this uncertainty the concealed interval is colored as Pleistocene on the map, such coloration being used only where the Pleistocene deposits are sufficiently extensive to render the areal mapping of the older rocks at all doubtful.

The Calciferous formation is a quite thick one in the Champlain valley, Brainard and Seeley having shown a thickness of 1800 feet in western Vermont. No complete section has been found in New York, but the different parts of the formation show much the same thickness as in Vermont, and the total thickness can not fall greatly short of the amount found there. The meager exposures at West Chazy do not suffice for the determination of the precise horizon in the formation. They lie close to a fault line, dip 5° to the east instead of in the usual northerly direction and may represent a small dislocated block produced by the faulting.

Chazy limestone. Only the extreme lower beds of this formation are shown within the map limits, occupying a narrow zone between two great faults, between which the Chazy is thrown down. The dip is away from the westerly and toward the easterly fault. The extreme base is not shown, but the lowest layer appearing is a light colored, calcareous sandstone which seems

very similar to the sandstone described by Brainard and Seeley as forming the base of the Chazy on Valcour island, and elsewhere along the lake.[1] The rock is peculiar and precisely like layers which are found in the Potsdam-Calciferous passage beds. Glittering cleavage faces of calcite, mottled with quartz grains, appear on broken surfaces. The quartz grains are set in a mosaic of minute dolomite crystals, while here and there later calcite has been deposited as a network around the quartz grains in crystals up to an inch in length, replacing the dolomite in those portions.

Above this layer appears some 20 feet of blue, crystalline limestone, following which are beds of gray limestone, spotted with yellow and full of fossils, to a thickness of 30 feet. The most extensive exposures are along the low ridge east of the big bend in Tracy brook. These upper beds are the same as those which form the base of Brainard and Seeley's section near Chazy village, but the basal 20 feet is below anything there seen.[2]

This lower Chazy limestone is, with the exception of the Pleistocene deposits, the youngest rock now found in the Mooers sheet area. There can be no question however that the remainder of the Chazy (750 feet thick), the Black river and Trenton limestones and the Utica slate (of undetermined thickness but at least 1000 feet) were originally deposited over the entire area. Then followed emergence and the long continued existence as a land region.

The Morrisonville well. Within the past two years drilling for oil has been in progress at Morrisonville, in Plattsburg township. The locality is 4 miles south of the map limits and nearly 3 miles west of its eastern edge. As soon as it was learned that drilling was in progress, a request was sent that a record and samples be kept. An unfortunate fire, however, destroyed the engine house in which the record was placed. A few samples had been kept elsewhere, and what follows is based on these together with the coinciding statements of the owners and the driller, these giving

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[1] Bul. geol. soc. Amer. 1891. 2:295.

[2] American geologist. Nov. 1888. 2:324.

only rough determinations, which however affect the value of the record less than would be the case were the rocks in the well less homogenous.

The drill at present rests at 1350 feet, and no work has been done for some months, though it may again be resumed. Some 20 feet of glacial deposit was passed through, and dolomite of Calciferous age was struck just below the river level, near which the well is located. Some 500 feet of Calciferous are shown in the well, and between 500 and 600 feet, the alternating layers of dolomite and sandstone marking the passage beds to the Potsdam, were met. The thickness of these could not be learned. The remainder of the well is in the Potsdam, mostly of hard, quartzose, white sandstone except for a considerable thickness of red beds, encountered between 800 and 900 feet. At the time of the writer's visit the well, at 1250 feet, was in resistant, white Potsdam, little other than quartz showing in the sample. F. E. Pierce of Morrisonville, one of the owners, writes me that the last 100 feet has been in precisely similar rock. This means that from 750 to 800 feet of Potsdam has been passed through in the well with no sign, as yet, of the arkose beds which always come in as the base of the formation is approached. The record is as follows:

	FEET
Pleistocene	20
Calciferous	500±2
Passage beds	50 (?)
Potsdam	775±2

In all this great thickness of Potsdam sandstone only one stratum was markedly water-bearing. A trifling amount of oil was also found in one of the beds.

Structural features

Foliation. This structure is confined to the pre-Cambrian rocks and was produced in them by deformation at a time when the present surface rocks were so deeply buried as to be beneath the level at which open fractures can exist. It is most prominent in the gneisses of the Dannemora formation, less well marked and

locally lacking in the gabbroic intrusions, and wholly absent in the later dikes.

The direction of strike of the foliation planes is quite uniform throughout the area of the sheet and beyond, being in general to the northeast. The more common direction is n 35° e, though the readings range between the extremes of n 10° e and n 50° e; variations of more than 10° from the usual direction are, however, uncommon. The prevailing direction of dip is to the northwest, this being uniformly true at the east and the west, while in the center of the sheet these are replaced by southeast dips. In general the dip is not high, seldom exceeding 45°, and usually flatter than that, often only 10° to 15°. The few good exposures show that the dip sometimes becomes momentarily high, quickly flattening again to the usual amount. The direction and dip of the foliation are common to gneiss and gabbro alike and must have a common origin. The foliation has a general parallelism to the longer axis of the intrusive mass of gabbro, yet continues unchanged so far to the south of that, with no apparent tendency to curve around its southern end, as to cause hesitancy in assuming that the compressive effect of the intrusion has been mainly instrumental in the production of the foliation. Farther, though observations on the foliation of the later hyperite-gabbro are somewhat unsatisfactory, they point to its parallelism with that in the other rocks and indicate that, in so far at least, the cause of the foliation is in no way to be ascribed to the larger intrusion. It is of course a possibility that the Rand hill gabbro is merely the bared, upper part of a great intrusive mass, much more widely extended beneath than the surface exposures give any indication of. The character of the rock, so like peripheral portions of the great anorthosite masses to the south, may be as well explained by this supposition as by the idea that it is a small, outlying intrusion, its character due to differentiation prior to its movement to its present position. The gently folded character of the foliation planes may give weight to the idea of a widely extended igneous mass not far beneath. In general it may be said, therefore, that the evidence is far from decisive as to the gabbro

intrusion being the cause of the foliation, nor does the latter show parallelism to the edge of the main intrusive masses of the Adirondacks. It can be equally well, perhaps better, explained as due to a force acting from the southeast, or from the northwest, presumably the former, and acting at several different times. On the latter assumption the decreasing perfection of the foliation in the successively younger rocks would be explained.

Nothing that could be definitely recognized as bedding has been observed in the Dannemora gneiss. Granite injections parallel to the foliation planes often give a bedding effect, as do also certain bands of hornblende gneiss, which cut across the foliation and are held to represent ancient, diabase dikes. With these exceptions the different varieties of gneiss fade into one another instead of being sharply marked off.

Faults. The region of which the Mooers sheet is a part is an excessively faulted one, not only great breaks but many minor ones occurring. Their detection is a matter of great difficulty over much of the territory, owing to widespread drift covering and specially to the uniformity in lithologic character of the pre-Cambrian rocks and of the Potsdam sandstone.

The greatest break known in the vicinity is that which has been called the Tracy brook fault.[1] This is easily traced, running in a northeasterly direction, across the whole of Chazy township with the Potsdam sandstone on one side and the various members of the Chazy limestone on the other, the entire Calciferous being faulted out. Its course is easily traced from the point where it enters the sheet, north of West Chazy, to the point where the brook leaves the fault line. Beyond, its course is conjectural. If produced, it would touch the northeast extremity of Rand hill, along whose eastern edge there is unquestionably a fault of great magnitude, the cliff being a fault scarp whose present relief is due to the more resistant character of the rock on the west, possibly aided by recent movement. The way in which the Potsdam contact on the north climbs the hill, rising from 800 feet to 1400 feet within a distance of 3 miles, is strongly

[1] 15th an. rep't N. Y. state geologist. 1895. p. 570.

suggestive of recent faulting and tilting, since there is no topographic break between the two rocks, yet one is far less resistant than the other.

The only difficulty in the way of considering this the prolongation of the Tracy brook fault is the sharp change in direction from southwest to south at the point of Rand hill. It is quite possible that this point marks the junction of the Tracy brook fault with a north and south fault, of whose existence the topography on that line north of Rand hill gives some evidence. At the best, however, this is not a fault of great throw, while that on the east edge of Rand hill is directly comparable in magnitude to the Tracy brook. As it can be traced to the south beyond the limits of the sheet and clearly connects with the Tracy brook fault, it gives great length and importance to this. If the writer be correct in the belief that the Calciferous comes clear to the edge of Rand hill, the entire Potsdam being faulted out, then the throw of the fault there is as great, or greater than at Chazy village, where it is about 2000 feet.

Another considerable fault occurs between the Calciferous at West Chazy and the Chazy limestone to the northward, the latter dipping directly toward the fault. The throw of this fault can not be determined owing to the uncertainty as to the precise horizon in the Calciferous of the West Chazy exposures.

Other faults or probable faults are (*a*) one in the extreme north that limits the passage beds on the west, which have a low northwesterly dip, yet suddenly disappear and are replaced by Potsdam to the westward; (*b*) a fault of unknown throw in the Potsdam at Jericho, with the red, basal beds on the east side and a coarse, glassy sandstone on the west, the one horizontal and the other with a 6° dip to the west; and (*c*) a more doubtful fault across Rand hill, separating the Potsdam and Dannemora gneiss on the west from the gabbro on the east.

In addition to these greater faults there are a multitude of minor breaks in the pre-Cambrian rocks at least, best shown by the aid of the later dikes. These are frequently found faulted a few inches or feet, little enough to make the identity of the

dike unmistakable, and frequently enough to emphasize the great number of these small slips that must exist. The slickensided character of many of the joint planes is evidence of slipping along them.

The faults run in all kinds of directions. The greatest breaks have a general north and south trend, though they may depart from this as much as 45°. Instead of being persistent in direction, they curve largely. The downthrow is always on the east side, with the result that progressively younger rocks appear as Lake Champlain is approached. The general rude parallelism of these faults cuts up the region into a series of long slices. These are cross-faulted, sometimes repeatedly as in the case of the block on the east of the Tracy brook fault, but usually much less frequently. The cross faults have a general east and west trend, but depart widely from that, and may or may not be normal to the main faults. No case has been met with where one crosses a main fault. They are necessarily of less magnitude though often with throws of many hundred feet.

The majority of the faults of the region are certainly normal (gravity) faults, and this is likely the case with all. The rocks lie in exceedingly gentle folds, and thrust faults, if present, must hade to the west, as all the great faults downthrow to the east. Across the lake the rocks are more sharply folded, and there thrust faults occur, but with a hade to the east.

Joints. All the rocks of the region are cut by joints and generally by several sets. Unfortunately observations on them do not suffice definitely to determine their character; observations on the strike are plentiful, but the dips can seldom be made out.

The most common direction of joints is a nearly north and south one varying between n 20° w and n. In nearly every case in which these are observed joints at right angles can also be made out, from n 70° e to e. In the majority of exposures these seem to represent the master joints. But northeast and northwest joints are nearly as common and in many exposures seem more prominent than the other set. There are evidently two sets of main joints, each consisting of a pair at right angles to each other,

and the two sets cutting one another at 45°. It is to be noted that while the north and east joints of the first pair are at 45° to the strike of the foliation planes, the northeast joints of the second set are parallel to and the northwest at right angles to these planes. Whereas therefore this latter pair of joints might have been produced by forces acting in the same direction as those which caused the foliation, the first pair could not have been so produced. It should also be noted that the first pair are more prominent in the Paleozoic rocks than are the second, while they are about equally developed in the pre-Cambrian rocks.

Many joints have been noted which can not be brought into either of these sets, but they are of much less importance and their significance is not clear. The numerous tension joints of the later dikes, which are manifestly due to contraction on cooling, are not here had in mind.

Wherever observations on the dip of the n 20° w and n 70° e pair of joints have been possible, they have been found to be vertical or very steeply inclined. But the northeast joints, those striking with the foliation planes, have been several times noted with dips of from 45° to 60° to both the southeast and the northwest, indicating that they are compression joints, and that the pressure came from the same direction as the earlier pressure which produced the foliation. In general these joint planes do not coincide with the foliation planes but are somewhat more steeply inclined. Observations on the dip of the northwest joints are practically lacking, though they seem to belong with the previous set and to have been produced at the same time. The vertical north and east joints are perhaps tension joints.

As the compression joints are lacking in the Paleozoic rocks, they must antedate the Potsdam. The prevailing east and west trend of the diabase and syenite dikes argues for an existing set of fissures with that trend at that time. The Palezoic rocks are also jointed, mainly by the north and east set. At least three, and probably several periods of joint formation are thus indicated.

Many of the joints are slickensided, indicating that slight slips have taken place along them, and not improbably a considerable

part of the readjustments of the region have been effected in this way, since many slight slips may involve as great an amount of shift as that concentrated along a single great fault.

Pleistocene deposits

. The retreating and disappearing ice sheet of the glacial period dropped its burden of transported rock material very unequally; much at points which mark pauses in the retreat; far less over places away from which the retreat was rapid; much also in the depressions of the preglacial surface, filling them often to the brim. In the district immediately under consideration glacial deposit, morainic and of till, is widespread but of very unequal thickness and with much bare rock showing. In places are very considerable morainic accumulations. The old preglacial valleys cut in the high plain level are refilled to that level, while the old hill tops and divides are but scantly covered.

Moraines. Much the most considerable line of morainic deposit is that banked up against the southeast face of Rand hill, climbing up and overtopping it to the south and swinging to the west up the north side of the Saranac valley, deeply covering all rock over a great area, and not improbably hiding the preglacial Saranac valley as well. The moraine is quite sandy, as is true of all moraines hereabouts, in consequence of the large content of material derived from the Potsdam sandstone. It is also very stony, and again material of Potsdam source is much the most conspicuous element. Locally the surface is exceedingly stony, Potsdam boulders by the hundred lying about together with crystalline rocks from Rand hill and rare Calciferous and Canadian pre-Cambrian blocks. This is undoubtedly the moraine mentioned by Baldwin in his paper on the Pleistocene of the Champlain valley.[1] This moraine, which covers all the south face of Rand hill and the low hills westward, as well as the south slopes of Dannemora mountain, so that all rock is hid and the pre-Cambrian–Potsdam contact efficiently concealed, would seem an unmistakable terminal moraine.

[1]American geologist. 1894. 13:894.

The east and west road in Beekmantown just at the south limits of the map passes over a series of ridges at progressively higher and higher levels, which somewhat resemble beaches in shape but do not seem to be such, as they consist in large part of rather coarse and not well water-worn material. It is probably to these that Prof. G. F. Wright alludes in a short paper, and these that he calls lateral moraines.[1] The writer has not given them sufficiently critical study to speak positively of their nature, but is disposed to agree that they are due to lateral streams along the edge of an ice tongue which lingered in the Champlain valley after the ice had disappeared from the hills. Deposits of apparently similar origin run north along much of Rand hill between the 600 and 800 foot levels. A single knob at the 700 foot level appears like an elongated drumlin, as suggested by Prof. Wright. Its surface is profusely covered with boulders and it is apparently of till, no exposures occurring. A little over a mile north of this drumloid hill is another knob of till or moraine at precisely the same level, and a mile and a half farther north, in Altona, is yet another of still more elongated shape. A satisfactory explanation of these three outlying knobs with identical summit levels has not presented itself.

In the northern half of Mooers the drift is very heavy and is morainic, though no bulky and conspicuous terminal moraine appears, and in general the moraine covering over the till is not thick, so far as can be judged by the few stream sections. The irregular, hummocky topography and numerous marshes are characteristically morainic. Yet occasional rock outcrops show in this belt, and the streams not infrequently show ledges in their beds. There is no indication that the ice made more than a very brief pause along this line.

Another similar east and west belt, with a breadth of some 2 miles, crosses southern Altona. Heavy boulder trains, mainly of Potsdam sandstone, are frequent on the surface. Like the previous belt, this does not mark a protracted pause in the general ice retreat.

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[1] American geologist. 1898. 22:333–34.

Glacial striae. Over a large part of the area of the sheet the striations on the rocks show that the ice which produced them was moving in a southerly direction. This is not the usual direction in the Adirondack region, and these markings were evidently produced by ice whose direction of movement was controlled by the meridional depression of the Champlain valley. On Rand hill the direction was midway between this and the usual southwesterly direction which prevails throughout the northern Adirondacks, the readings varying between s 5° w and s 30° w.

Water levels. Signs of the action of standing water are numerous in the region, but the writer has been unable to give them the attention they deserve and can speak of them only in preliminary fashion. Fragmentary beaches and terraces are found at the 360 and 440 foot levels, less well marked at 280 feet and somewhat doubtfully at 540 feet. The two best defined levels are marked by fragmentary beach ridges, behind which are often long narrow marshy strips, and by sand delta levels in the Little Chazy river. North of West Chazy what resemble cliffs and wave-cut terraces appear at these levels, but some hesitation is felt in ascribing this origin to them, since they are found at other levels also, and the rocks are so resistant that the length of time required for the work would seem out of all proportion to the length of time during which the water stood at these levels, as indicated by the strength of the beaches and delta terraces. Wave action was probably effective in sweeping away all fine material from the benches, but that they were cut by the waves is not thought probable. The cliffs may be fault scarps.

Baldwin reports marine shells from Plattsburg township at 346 feet, and there can be no question that the water level at 440 feet represents marine submergence to that depth. But signs of wave action between 500 and 540 feet were noted in several places, and it should be added that one of the great sand terrace levels in the Saranac valley has the same altitude. On the turnpike at West Beekmantown and southward is much sand at 520 to 540 feet with strong resemblance to a beach. There is a sand ter-

race level along the river west of West Chazy at the same elevation. In eastern Altona at the same level rather gravelly ridges are found at two or three points which resemble beaches. On the road west from Sciota to Altona village, similar ridges appear at 480, 540 and 580 feet, built up on the sandstone ledges of the Flat rocks, all beach-shaped but with much coarse and not well rounded material. At 500 feet is an interesting little gravel bar, like a spit, now cut through by a small stream. These Altona ridges have considerable resemblance to those in Beekmantown already described and may perhaps also be referable to lateral stream action along a Champlain valley ice tongue, but their persistence at about the same level, and the correspondence of this with the delta level in the Saranac valley, seem to indicate strongly static water action. It need not necessarily mark a marine level, as there are fresh-water levels above the marine shore lines in the region, but, on the other hand, the hight reached by the marine levels on Mt Royal at Montreal would seem to imply a marine level along Lake Champlain at least as high as this.

These shore lines in the Champlain valley rise in level when followed northward, showing that they have been tipped since they were formed, but, till they shall have been more carefully followed and identified along the full length of the valley, uncertainty must prevail in respect to the amount of canting.

The Flat rocks

The Flat rock district in Altona is a most impressive region. The naked ledges of horizontal sandstone, rising slowly in a series of gigantic steps with wide tread and low rise, are extremely striking. That the ice could have melted away from the region so rapidly as to leave no deposit here is not to be thought of. Deposit evidently was left and has since been removed. Some four years ago G. K. Gilbert, who had recently returned from a short visit to the region, suggested in conversation that here was the route of a spillway. As the ice retreated away from the northern foothills of the Adirondack region, the waters of the

glacial lake Iroquois, which occupied the Ontario basin and had its outlet at Rome into the Mohawk valley, because the St Lawrence outlet was still blocked by the ice, would have commenced to discharge around on the north along the edge of the ice as soon as it had sufficiently retreated to uncover lower ground than that at Rome. By a spillway such an outlet is meant. As the ice farther retreated down the slope, the stream would fall to successively lower levels, bringing down the level of Lake Iroquois correspondingly. Such a current as this would have been would furnish an adequate explanation of the naked rock surface of the Flat rocks. The writer's observations have not been sufficiently extensive along the north side of the Adirondacks to enable him either to affirm or to deny the correctness of this view, and, as the results of Mr Gilbert's observations have not been published, it is not known on what data the identification of this spillway rests. But such results would naturally have followed the change in outflow of Lake Iroquois from the Mohawk to the St Lawrence valley, and spillways would likely have existed at several levels as the waters fell. Various lake levels should also have existed for at least a brief time along the northern Adirondack slopes, and may well have left discoverable traces, which should have definite connection with such spillways as may exist. The region is a difficult one, but a great opportunity awaits the individual who can take the time to cover the region thoroughly, unhampered by other and more pressing work. The new maps will be a great aid when completed.

The larger part of the bared surface in the Flat rock district lies between 600 and 800 feet elevation. Over large areas the surface is absolutely naked except for an occasional large boulder. This altitude is so much below the level of the Iroquois beach, if extended to this point, that, if it be the path of a spillway, it should be from a water level considerably lower than the main Iroquois plane, and it would seem as if marks of standing water at this lower level should be found when search is made.

Just below the eastern edge of the bared rock area in eastern Altona is an exceedingly interesting ridge of coarse cobbles which

commences near the Little Chazy river at the 640 foot level and runs to the north for some distance along the base of Pine ridge. The ridge was followed for over a mile, and that seems but a small part of its length. The boulders are all fairly well rounded. No material of less size than an inch in diameter is found, and the range in size is from that up to from 9 to 12 inches. Only an exceptionally strong current could have moved material of this size and carried away everything smaller. As the belt is followed northward, it broadens somewhat, suggesting that there may have been some creep down the hillside. For the mile that it was followed the belt appears to be horizontal instead of lying on a grade, a fact also noted by Mr Gilbert and mentioned in conversation. It was at first thought that this cobble belt furnished strong corroborative evidence of a spillway channel, its present position marking the ice edge down against which the material was washed, since, had the ice not been there, it should have been washed farther down the slope on which it lies. But it is hard to explain the unchanging altitude on this view, since a sufficiently strong current to account for the phenomena would seem to require considerable grade. However, the altitude has not been carefully leveled; so there may be sufficient fall to have given a stream of large volume in a restricted channel the requisite velocity. No alternative explanation has occurred to the writer.

Economic geology

There is little of economic importance within the area of the Mooers sheet. There may be deposits of magnetic iron ore in the extreme southwest, but no disturbance of the compass has been noted, and it is exceedingly improbable that there are any of large size or economic importance.

The Calciferous and lower Chazy limestones about West Chazy do not produce a quality of lime that will compare with that obtained from the Black river and middle Chazy limestones along the lake, and have no importance in view of the nearness of the latter. Much of the Calciferous will furnish an excellent road

metal, when the demand for better roads shall arise, but within the sheet limits it is mostly under deep cover.

There is a vast amount of good building stone in the district, most of which is unfortunately situated as regards access to market. Both the pre-Cambrian rocks and the Potsdam sandstone will furnish good stone.

There is an old quarry in the Potsdam on Rand hill by Sandburn brook in a red, massive sandstone belonging in the basal part of the formation. The stone is quite like that quarried at Potsdam in character, though of a deeper red shade, and seems of an excellent quality. But, as shown in the quarry face, there is only a thickness of 5 feet of good stone, and the lateral extent is problematic, as the pre-Cambrian rocks appear within less than a quarter mile on either side. The quarry has not been worked for years, and had only a local use, but furnishes the best appearing stone that the writer has noted in the district. But much of the ordinary, light colored stone in Altona, Mooers and Chazy would furnish an excellent building stone, with a minimum of labor in quarrying, as there is no stripping to be done. It is not, probably, of such extra fine quality, all things considered, as to create a widespread demand, but is more than ample to satisfy all local requirements.

Of the pre-Cambrian rocks the anorthosite-gabbro seems of the most value. Much of it would make an excellent paving stone. Well granulated, anorthositic rocks are exceedingly tough, and a rock very similar to that on Rand hill is used for paving in the city of Montreal and gives good satisfaction.

Fair to good building stone is furnished by the Dannemora formation, the anorthosite-gabbro and the syenite. The new state building at Dannemora is constructed of a dark red, granitoid gneiss of the Dannemora formation, obtained close at hand on the south slope of Dannemora mountain, the stone being strong and durable when carefully selected, and of quite pleasing appearance.

Recently W. M. Carnes of West Chazy has commenced quarry operations on Rand hill, in both the anorthosite-gabbro and the

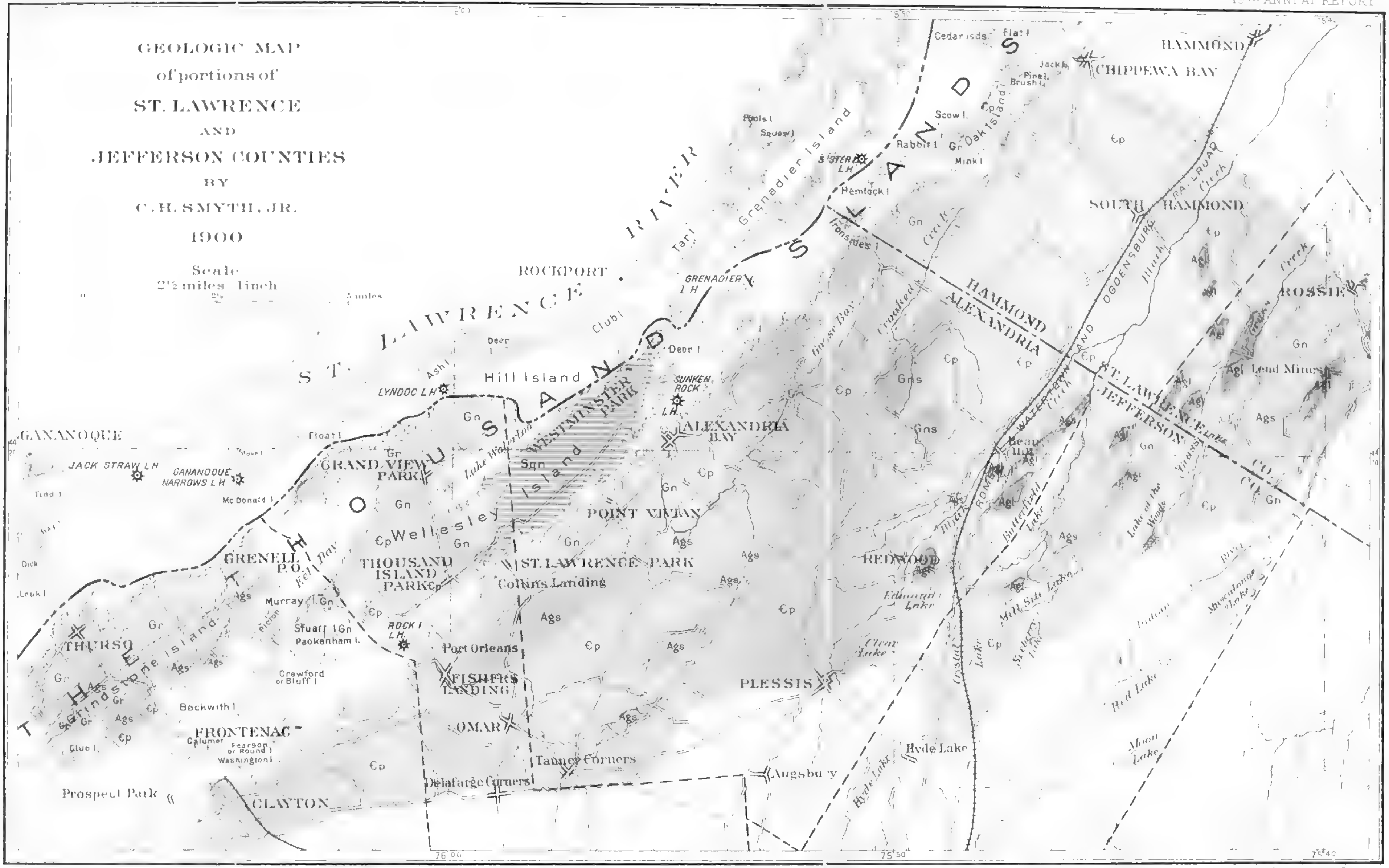
syenite. The former stone is quite like that quarried at Keeseville and called erroneously "Keeseville granite", the rock being a gabbro and very similar to the Rand hill rock. It is a very handsome, strong stone, takes a beautiful polish and would seem to be well adapted for structural and ornamental purposes. It would certainly seem as good as the Keeseville rock but has not been sufficiently investigated to enable any precise statements of its value to be made. The numerous diabase dikes are something of an impediment to quarrying operations, specially as the adjacent gabbro is apt to be excessively jointed and useless.

The augite-syenite furnishes a greenish black, fine grained rock which is also strong and takes a fine polish. The change in color which this rock experiences on exposure may prove harmful. This change takes place rather rapidly, though it varies in different parts of the rock and may be a matter of a considerable number of years in this case. There is however but little of this rock on the hill, as has been previously noted. It should also make a good paving stone, as well as a valuable road metal. For this latter purpose the gabbro will also serve excellently, and much of the Dannemora gneiss as well, though in using the latter care must be taken not to use material of varying hardness on the same piece of road.

GEOLOGY OF THE CRYSTALLINE ROCKS IN THE VICINITY OF THE ST LAWRENCE RIVER

BY

C. H. SMYTH JR



Єp	Potsdam sandstone
Agl	Crystalline limestone
Ags	Schists and quartzites of limestone series
Sqn	Schists and quartzites, with much granite-gneiss.
Gns	Granite-gneiss with much schist and quartzite
Gn	Granite-gneiss
Gr	Granite

GEOLOGY OF THE CRYSTALLINE ROCKS IN THE VICINITY OF THE ST LAWRENCE RIVER

In earlier reports and papers the writer has presented the results of a general reconnaissance of the western Adirondack region, including under this designation the relatively low lands of central and western St Lawrence county and eastern Lewis and Jefferson counties, which, though topographically quite different from the Adirondack region proper, can not be differentiated from it geologically.

The present report deals in a similar manner with the small area of crystalline rocks along the St Lawrence river, which, on existing maps, is cut off from the main body to the southeast by a narrow strip of Potsdam sandstone. The rocks in question are, of course, beneath the sandstone, continuous with the main body, and must be treated as such rather than as anything distinct.

The region studied embraces the whole of the town of Alexandria and parts of Clayton and Theresa in Jefferson county, together with portions of Rossie and Hammond in St Lawrence county. Within this area are included the Thousand islands of the St Lawrence river.

As might be expected, the rocks of this region fall in with the types described in former reports, though there are some interesting variations, and a number of exposures giving data of an unusually positive nature.

For the purpose of mapping, the rocks were divided into four formations, whose character, origin, and interrelations form the theme of this communication. The topography is so closely dependent on the nature of the rocks, that it is best treated, however briefly, after the rocks have been described. The rock classification is tentative in many respects, and the interpretation of the mapping involves a consideration of the conditions which require, for the present, such a tentative method.

As shown on the map, the four rock types are crystalline limestone with schists, gneiss, granite, and Potsdam sandstone.[1]

The term, schists, is here used to include a variety of rocks, such as quartzite, hornblende and mica schists, hornblende, pyroxene and mica-gneisses, etc. These rocks may occur singly, but most frequently are intimately associated with one another and with the crystalline limestones in long belts. While in the belts farther south the crystalline limestone is more abundant than the schists, the reverse is true in the region here treated.

These belts are characterized by their heterogeneity and in particular by rapid changes in the nature of the rocks across the strike. The whole aspect of such a belt is that of a highly metamorphosed series of sedimentary rocks, and as such its rocks are classed with the utmost confidence. The quartzites and marbles represent originally pure sandstones and limestones, while most of the schists and gneisses are the metamorphosed shales, impure sandstones and limestones, etc. However, it is probable that some of the schists are altered igneous rocks, (perhaps, in part, contemporaneous volcanics) which are intermingled with the sediments and so thoroughly metamorphosed that their original character is entirely obliterated. Such rocks, if present, must be treated as part of the sedimentary series, and as yet no effort has been made to determine their existence.

Scattered areas of unchanged intrusive rocks are known to occur within the schists at many points, but, as a rule, are too limited in extent to appear on a map of small scale.

The gneiss of the area under consideration is fairly uniform in character, though, as shown below, not all of the same age. In general it is of medium grain, and pink, red, or gray in color. In texture it ranges from strongly foliated to entirely massive, in the latter case becoming essentially a granite.

The foliated and massive varieties shade into each other, and in most cases are clearly different phases of one and the same

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[1]Diabase dikes identical in character with those of the Admiralty islands previously described by the writer (N. Y. acad. sci. Trans. 13: 209-14) are abundant on Grindstone island, and occasionally are seen elsewhere. Small intrusions of hyperite, also, are sometimes encountered.

rock. In consequence, foliation is no criterion for the correlation of different areas of gneisses.

As a matter of fact, there is abundant evidence that the gneiss formation is not a unit, but rather a complex, so far as age is concerned; while the different parts have so much in common as regards origin and history that their separation is practically impossible. Thus the gneiss is treated as a unit in mapping, though its complex character is fully recognized. However, such treatment seems justifiable on theoretic as well as practical ground, since it is probable, first, that the differences of ages among the gneisses are relatively slight, and second, that the rocks had a common source. These points have been treated in previous reports at such length that farther reference to them may be omitted for the present.

As elsewhere in this part of the state, the gneisses are the most widespread of the pre-Cambrian rocks, occurring in large irregular areas around the belts of schists and limestones, and also in minor amount within the latter. It is often difficult to draw a definite line of demarcation between the two formations, since, in some cases, the schists approach very closely to the gneisses in composition and texture.

As these two formations, together with the granite, were the chief object of field study, their distribution and relations are best considered before passing on to the Potsdam.

Beginning at the northwestern limit of the region studied, which corresponds with the international boundary line, Wells[1] and Grindstone islands afford an epitome of the geology, as all the formations encountered are shown on them.

The northeast half of Wells island consists chiefly of the schist formation, of which two members appear. On the east is a very gneissoid member, so difficult to distinguish from the true granite gneiss that their distribution as shown on the map must be regarded as quite conjectural.

On the west side of the island, beginning at Westminster Park, is a high ridge of white vitreous quartzite with just enough feld-

[1]Or Wellesley.

spar, or mica, or both, to give it foliation. Though broken at intervals, this ridge is quite persistent for four or five miles, when it disappears, being, like the gneissoid schist to the southward, cut out by the great mass of granite-gneiss that makes up the southern end of the island.

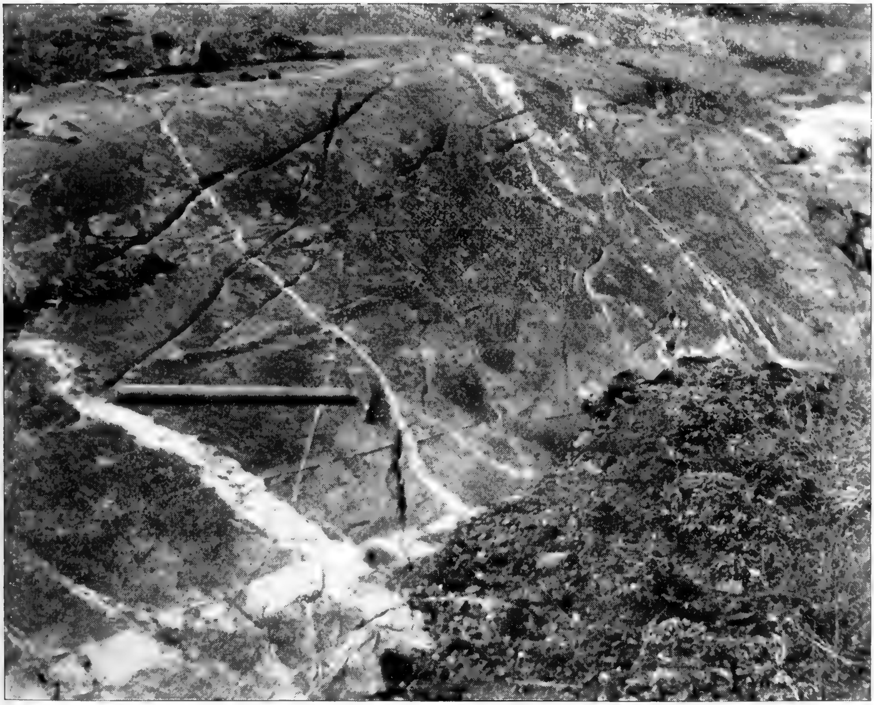
With a single exception to be mentioned below, the writer has seen nowhere else in the crystalline area a body of quartzite so large and so pure as this, and it is of particular interest as affording an unquestionable example of a pre-Cambrian rock of sedimentary origin. In the highly metamorphic series, estimates of thickness must always be quite hypothetical, but in this instance, 500 feet would seem to be a very conservative estimate of the thickness of the quartzite. The strike of the belt and of its foliation is n 45° e and the foliation dip 80° n.

Though these members of the schist formation make up the great part of this end of the island, the granite gneiss is not wanting, but appears in scattered areas of limited extent. There is abundant evidence that these masses of gneiss are younger than, and intrusive in, the schist. Masses of gneiss of considerable size break through the schist and quartzite in the most irregular fashion, while the latter rocks are penetrated by granitic dikes which range from fractions of an inch to yards in width. These dikes are usually, though not always, more massive than the bulk of the gneiss, and often coarser grained, even pegmatitic, but that they are offshoots of the gneiss is evident. The same structural differences have been noted in similar instances described previously.[1]

Farther and even more striking evidence of the relation of the two formations is afforded by great quantities of inclusions of schist and quartzite in the gneiss. These vary greatly in size and shape, though, particularly in the case of the well foliated and banded schists, they are apt to be elongated in the direction of foliation. In some cases, indeed, they appear as dark bands in the gneiss, looking at first sight like broken dikes. Occasionally

[1]Crystalline rocks of St Lawrence county, 15th an. rep't N. Y. state geologist. 1895. p. 491.

Plate 13 To face p. 188



C. H. Smyth jr, photo.

Network of granite dikes in schist. Near Westminster park, Wells island

inclusions of schist seem to have been slightly blended with the gneiss by melting, but as a rule the boundaries are sharp, and are always so in the case of quartzite. The latter rock, being more massive, is less apt to furnish elongated inclusions. As in other parts of the region, the elongated inclusions nearly always are placed with their long diameter, parallel to the foliation of the gneiss.

These phenomena of dikes and inclusions are of the greatest moment, since they afford the chief criteria for establishing the origin and age of the gneisses. This is particularly true of the inclusions, since the heart of the Adirondack region consists almost wholly of gneisses, the only positive and direct evidence as to whose origin, so far as the writer is aware, is afforded by scattered inclusions analogous to those above described. For this reason these phenomena demand farther brief consideration.

The localities described, and others mentioned below, are of particular importance, because the phenomena are presented with such diagrammatic clearness that they admit of but one explanation. At the same time, it is evident that they are strictly analogous to cases farther south, which, though more obscure, were interpreted in the same manner, as stated at some length in the report for 1895.

As there stated, the phenomena described might be regarded as broken intrusions, segregations, or inclusions, and reasons were given for concluding that they were the latter. In the present instance, though we have to deal with similar phenomena, it is possible to come to but one conclusion in regard to them.

The schists and quartzites, as seen in place, are found to be cut and veined in every direction by a granite-gneiss, and fragments of schist and quartzite, in every way identical with the main mass, are scattered through the granite-gneiss, and are themselves penetrated by networks of dikes running in from the latter.

The composition and structure of the fragments are, in themselves, enough to show that they are neither intrusions nor segregations, while it is clear that they were solid when the

surrounding gneiss was still fluid, since the latter penetrated them to such a marked degree. Indeed, this is one of the most striking features of the phenomena, minute dikes of granite, sometimes strongly puckered, extending for yards through the schists.

To make this possible a high degree of fluidity would seem to be demanded, together with intense pressure. It is not uncommon to find the schist a network of these minute dikes, hundreds of feet from any large exposure of granite-gneiss. In such cases, of course, it is quite possible that a body of granite-gneiss may lie at a small depth, or that a sheet may have been eroded from above.

As a rule, contact metamorphism is nearly lacking in this region, but some curious examples of it are shown in Westminster Park, also near the highway $\frac{3}{4}$ of a mile west, and near the river bank just opposite Alexandria Bay. The schists here range from nearly white to nearly black, through gray tints. They are cut through and through by reddish granite dikes, the narrow ones being massive and the broad ones quite gneissoid. Along the margins these dikes frequently show much black tourmalin, and this is usually most abundant in the very narrow ones, in which the imperfect crystals of tourmalin interlock across the entire width. At the same time, the schists along the contact become impregnated with fine granular tourmalin, producing strips and irregular areas of a lustrous black rock. The remarkable feature about these contact zones in the schist is their extreme irregularity in form and extent and their entire independence of the magnitude of the accompanying dike. A dike of granite a foot wide may have no contact zone, while a mere thread of granite, a few feet distant, may be bounded on each side by a band of the tourmalin rock two or three inches wide. Again, the tourmalin, instead of forming a continuous band, appears in lumps and bunches of every conceivable shape, irregularly scattered along a dike, and sometimes extending several inches away, at right angles to the course of the dike.

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C. H. Smyth jr, photo.

Branching dikes of granite gneiss in schist. One mile east of Westminster park, Wells island

Frequently the offshoot which gives rise to a tourmalin mass or band consists of nearly pure quartz instead of granite, and every gradation between the two may be traced. Evidently, in this instance, the quartz is playing the role of an intrusive, being the ultra-acid phase of igneous activity.

As stated above, the southern end of Wells island is made up of gneiss, but on account of the intermingling of the two formations by intrusion, and the gneissic character of much of the schist, the lines between them can not be accurately drawn. Along the approximate lines of contact, east of Thousand Island Park, there are some fine instances of dikes and inclusions.

Near the southwest corner of the island, in the neighborhood of Grandview Park, a very coarse and massive granite-gneiss appears. The relation of this rock to the ordinary granite-gneiss could not be determined, no data being found to decide the matter. As the rock is the same as the well-known granite of Grindstone island, this point is best considered in connection with the latter.

Grindstone island, though two thirds as large as Wells, is much less varied in its geology. It consists for the most part of the coarse hornblende-granite, with scattered masses of quartzite and schist, forming ridges of some extent, and also appearing in numberless inclusions in the granite. As these quartzites and schists are identical in character with those described above, they demand no farther consideration.

The granite ranges from very coarse to very fine in grain, and, though usually rather massive, always shows a trace of foliation, and often passes into a well foliated gneiss. The color is generally red, but may become grayish. It is a hornblende-biotite-granite, usually with much quartz, which is either bluish or opaque white.

As above indicated, this granite bears to the schists and quartzite the same relation as does the gneiss of Wells island, and all the phenomena of dikes and inclusions are repeated in it, with the exception of the tourmalin contact zones, none of which were seen.

But as regards the relative age of the granite and the granite-gneiss there is less certainty. As a whole, the granite is more massive, and thus a younger looking rock than the gneiss, but when the former becomes well foliated, as it often does, it is practically identical with the gneiss. The most constant petrographic distinction in the field is the presence of the opaque white or blue quartz in the granite, but even this fails in the gneissic phases. Coleman[1], in describing the same granite in the Canadian islands, mentions it as cutting and including the gneiss, and his data are conclusive, but it is not certain that he uses the term, gneiss, in the sense in which it is here employed. Certainly, the writer could find no instances of the granite cutting the granite-gneiss, or of inclusions of the latter in the former, though inclusions of the quartzite and schist are abundant.

As above stated, the term, gneiss, is here used to embrace a complex of granitic gneisses, known to vary in age, though all are younger than the schist, but so closely related and so intermingled that their separation is often impossible. It would be entirely consistent to map the Grindstone island granite as a part of the granite-gneiss, regarding it as probably the youngest member of this complex formation in this vicinity. But, on account of the prevailing massive habit of the granite, which, with its location, tends to differentiate it, also on account of its previous classification, it is here mapped separately. That it has a close genetic relation to the granite-gneiss as a whole, and is identical with part of the latter as here mapped, is certain. Indeed, the distinction between the two rocks on Wells island is conjectural. In these respects, the granite occupies a position similar to that of the granites in Gouverneur and the syenite in Diana, described in previous reports.

Passing to the south bank of the river, the granite-gneiss mixed with schist stretches from Chippewa to Collins Landing, a distance of about 20 miles.

A beautiful instance of schist inclusions in the granite-gneiss is shown at Alexandria Bay, in a lot at the corner of the Red-

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[1]Canadian record of science. 1:127.

Plate 15

To face p. r93

C. H. Smyth jr, photo.

Faulted granite dike. Near Westminster park, Wells island

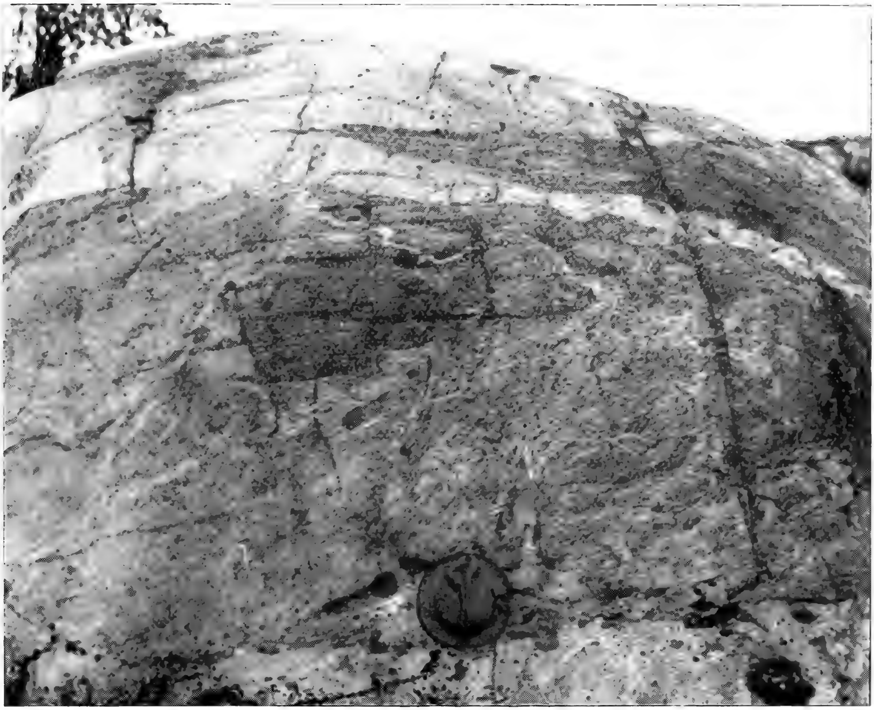
Plate 16

To face p. r93

C. H. Smyth jr, photo.

Inclusions of schist in granite-gneiss. One half mile west of Alexandria bay on Clayton road

To face p. 193



C. H. Smyth jr, photo.

Inclusions of schist in granite-gneiss. Two miles west of Alexandria bay

Plate 18

To face p. r93

C. H. Smyth jr, photo.

Sheets of granite-gneiss intruded parallel to foliation of schist. Two and one half mile west of Alexandria bay

C. H. Smyth jr, photo.

Branching dikes of granite-gneiss in schist. Two and one half miles west of Alexandria bay

wood and Clayton roads. All of the features of such occurrences are perfectly shown on a glaciated surface, some hundreds of square feet in extent. The schist here is a light pinkish gray and might be taken for a fine variety of the granite-gneiss, but the latter cuts it in every direction in dikes varying from several feet down to a fraction of an inch in thickness. At a few points the tourmalin zone is developed, but it is generally lacking.

A minor feature, as at many similar localities, is a series of small dislocations, faulting the dikes two or three inches or less, a great many times, as shown in plate 15. Here quartz veins are subsequent to the faults, cementing the fissures.

Similar phenomena are shown along the Clayton road, west of Alexandria Bay. The gneiss is the country rock for several miles, and the almost continuous exposures present many fine examples of inclusions.

Half a mile south of this road, there is a ridge of schist some two miles in length and a half mile or more in width. The rock is for the most part strongly foliated and banded, with granulitic texture, crumbling to sand when weathered, and of a green or alternating green and pink color.

In composition it is chiefly pyroxene, feldspar and calcite with epidote. Such a schist might be derived from a basic igneous rock or from a very impure limestone, and, as similar rocks occur in association with crystalline limestone a few miles away, the latter origin is assumed as true for this one.

This ridge is remarkable for the abundance of intrusions of the granite-gneiss; indeed, the writer can recall no other locality where the phenomena of intrusion are so beautifully shown. In every direction bosses, sheets and dikes of the pink or gray granite-gneiss break through the dark schist, and the sharp contrast of color adds much to the clearness and beauty of the exposures.

There is a marked tendency in the intrusions, large and small, to follow the foliation of the schist, and some sheets have the appearance of interbedding; but exceptions to the rule are

abundant, the dikes running in every direction, and often branching.

Plates 18 and 19 illustrate both cases.

A somewhat peculiar feature of these exposures is the entire absence of contact metamorphism. When an acid intrusive cuts a basic calcareous schist, contact minerals would be expected, but none occur here. Even the small tourmalin zones, developed elsewhere under what would seem much less favorable conditions, are lacking.

However, while contact zones fail, some interesting mineral localities occur on the ridge. The pegmatitic aspect of some of the dikes led the writer to think that somewhere in the schist would be found the localities which furnish the well-known specimens of flesh colored orthoclase and specular hematite which are, in many mineral collections, labeled as coming from Alexandria. Such proved to be the case, these minerals occurring in very acid pegmatites, so acid indeed that sometimes they are little more than quartz veins. The specimens are so well known as to require no description. These mineral veins cut directly across the foliation of the schist and are sharply defined. Seen by themselves, with the predominance of quartz, and the presence of some calcite, they would perhaps be taken for purely aqueous veins. But in the presence of the granite dikes, between which and the veins there are various intermediate forms, it seems practically certain that these mineral veins are igneous in origin, presumably representing a very late stage of activity, in which vapors and hot solutions played the chief part.

Two dikes of diabase were also noted in this ridge, but they have no special significance.

A mile farther south is another ridge of schist similar to the above and to be classed with it. But it is comparatively lacking in intrusions of the granite-gneiss and presents nothing of particular interest. This absence of intrusions in the ridge may be due to its being farther from the contact with the granite-gneiss, but the surrounding Potsdam hides all evidence on this point.

The large swamp east of Alexandria Bay is a tangle of schists and granite-gneiss so confused that their separation is almost impossible, and the mapping must be taken as merely a rough approximation to accuracy.

Continuing southeasterly, the schists again appear in the neighborhood of Redwood, and extend in a broad belt northeastward to Black lake. This is one of the most interesting of all of the belts of the metamorphosed sedimentary series in this part of the state, on account of the variety of rocks it contains. Crystalline limestone, coarse grained white and graphitic, is abundant and serves to correlate the formation with the extensive limestone belts farther south. This rock appears in small quantity about a mile north of Redwood, and is widespread to the east of Butterfield lake. Typical vitreous quartzite is another important feature of the belt, forming a high steep ridge south of Butterfield lake, along the road from Redwood to Rossie. The rock is identical with that of Wells island, and thus serves to connect the latter, together with its associated schists, with the crystalline limestone formation.

Across the road from the quartzite, another high ridge occurs, made up of hornblende, mica, and pyroxene schists and very impure limestones. The pyroxene schists are so closely similar to those of the schist ridges above described that, as already stated, there can be no doubt that the latter also are to be regarded as belonging to the limestone formation. This correlation is rendered even more sure by the fact that these rocks near Butterfield lake bear the same relation to the granite-gneisses that the other schists do. This is clearly shown by dikes of the pink granite and granite-gneiss cutting the schists near the quartzite ridge, and reproducing all of the structural features shown in the localities before described.

This locality is of much interest, as it affords an excellent showing of the crystalline rocks that are regarded beyond question as of sedimentary origin. Quartzite, dark hornblende schist, mica schist, pyroxene schist, and pyroxene and mica gneisses with impure limestones succeed each other rapidly and abruptly

across the strike, which is northeast with a prevailing steep dip to the south. It is hardly possible that this is anything but a sedimentary formation, and in every way it is in striking contrast with the granite-gneisses, which are certainly igneous.

As has been frequently stated in previous reports, such localities are important as standards of comparison in determining the nature of rocks which, on account of their isolation or of poor exposures, give no direct evidence of their origin.

But even in this belt there are some rocks of doubtful character—certain light colored acid gneisses, which are massive and look like granites, though in many respects they behave like constituent parts of the sedimentary series. It is likely that both igneous and sedimentary gneisses are here represented, but their differentiation will require much close work.

In regard to the distribution of the granite-gneisses but little need be said, since it has been already stated that they occupy all of the areas between the schists, not covered by the Potsdam. A few of the gneiss localities, however, demand special mention. Of these, perhaps the most important is about half a mile north of the old military road leading from Redwood to South Hammond, and beside the road running north to the river, 1½ miles east of the former place. This locality is important because it shows clearly the complex nature of the granite-gneiss. A rather coarse, dark, grayish red gneiss is cut and veined by a fine, light pinkish red gneiss. If the two rocks occurred in distinct outcrops but slightly separated, they would, almost without question, be regarded as parts of one and the same rock, and it was only after the careful examination of several outcrops that the writer felt convinced of their difference in age. The exposures, in an open field, are numerous and excellent, showing sharply defined contacts between the two gneisses, with no gradation between them, and with clearly marked dikes of the fine gneiss cutting the coarse. With poorer exposures, such for instance as generally occur in wooded districts, this difference in age would probably be overlooked; and even where it has been fully established, the actual separation of the rocks in mapping remains a

matter of the utmost difficulty. It could be accomplished only on an accurate map of large scale.

One farther point of importance requires statement. Both gneisses, the coarse and the fine, contain characteristic inclusions of the schist, and so the older as well as the younger, as would be thought from its appearance, is igneous, and both are younger than the limestone formation.

It happens that one of the widely scattered occurrences of hyperite is located here, numerous dikes cutting both gneisses so that the locality has the interest, rather unusual for this region, of showing within a radius of a few rods rocks of four different ages, clearly defined, while a fifth age is shown in the Potsdam, hardly half a mile distant.

A similar complexity in the gneiss is indicated about one and one half miles north of Redwood on the road to Alexandria Bay, but the phenomena are not clearly shown, and admit of a different interpretation.

One half mile north of Grasse lake, in the midst of the great sedimentary belt described above, there is a bold ridge of very coarse, porphyritic red gneiss. It is of a decided red color, with feldspars an inch or more in length, and is well foliated, resembling closely the coarse porphyritic and augen gneisses so common farther south. Frequent bands and masses in the rock are quite different, being decidedly fine grained. But after a careful examination the writer was unable to decide positively whether there is a difference of age similar to that described above, or the fine gneiss is simply a phase of the coarse. The former is probably the case, but the question is an open one.

The coarse gneiss is clearly igneous, containing many inclusions of the schist. One of these merits particular mention. A knoblike exposure a few yards in extent shows on one of its rounded sides a sharp contact between the gneiss and the schist. On the opposite side, the gneiss appears in little strings and lumps, somewhat puckered, scattered through the schist in lines parallel to its foliation. The result is the production of a sort of injection gneiss of very peculiar aspect, whose origin would be a

matter of much doubt, did not the nature of the exposure make it clear. The accompanying plates give a very imperfect idea of the phenomena.

In all the above cases of a certain or probable difference of age in the gneiss formation, it is highly probable, from the nature of the rocks, that they have come from a common source, and that no great interval elapsed between the periods of eruption.

About two miles south of South Hammond, near the road to Rossie, the granite-gneiss shows a peculiar pegmatitic phase, probably relatively late, packed with schist inclusions of every conceivable shape and size, which are themselves penetrated by dikes of granite and veins of quartz in great variety. For an exhibition of all these phenomena, the locality can hardly be surpassed, and is thus important as a basis of comparison.

Nearly everywhere in the region studied, the Potsdam sandstone is a conspicuous formation, on account of its quantity and its mode of occurrence. As a whole, it is a rather fine grained sandstone, consisting almost entirely of well rounded quartz grains cemented by secondary quartz. It is very uniform over wide areas, showing almost no variation except in color, the prevailing light gray or white being frequently replaced by red, sometimes with complex striping and mottling. In general, the bedding is practically horizontal, although gentle dips are not uncommon. Occasionally steep dips are shown; a conspicuous example being in the village of Theresa, where some rather sharp folds appear.

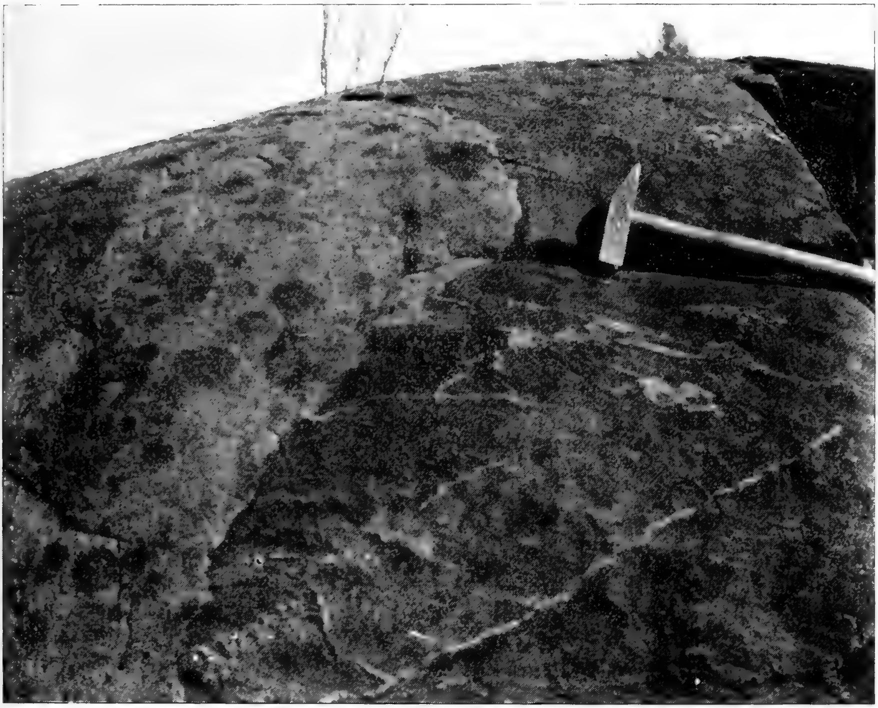
The upper part of the Potsdam is calcareous, and it doubtless passes gradually into the Calciferous, as it does, according to Cushing[1] in Clinton county.

The actual base of the Potsdam, in contact with the underlying crystalline rocks, was seen at only three points. One of these is on the road from Redwood to Rossie, where it descends the Potsdam escarpment, just west of Mill-site lake. The flat Potsdam rests on the eroded edges of a much decomposed ferruginous schist. The bottom layer of the Potsdam, varying from 1 inch to

[1] 15th an. rep't N. Y. state geologist. 1895. p. 511.

Plate 20

To face p. r98

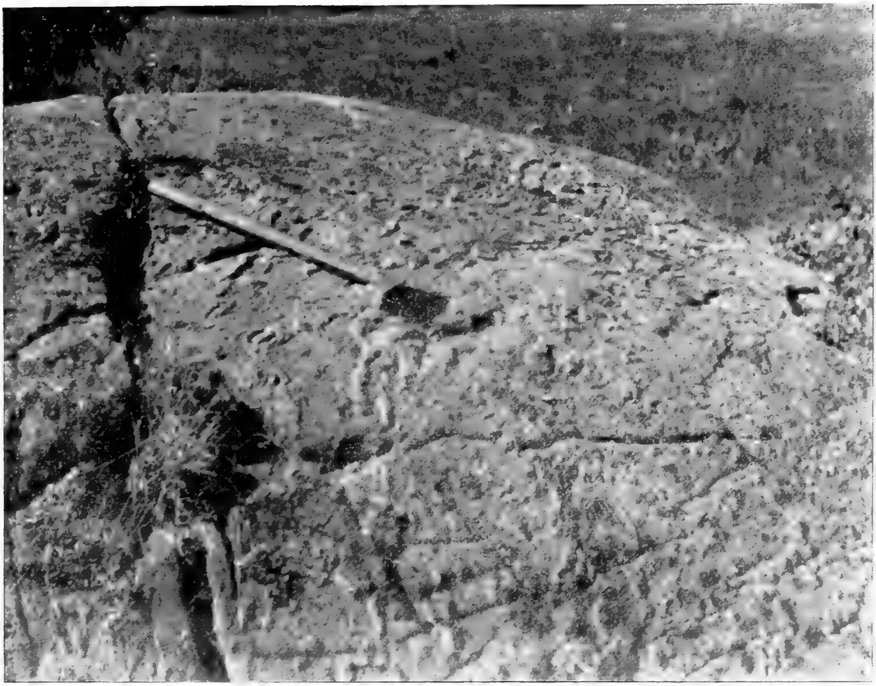


C. H. Smyth jr, photo.

Contact producing injection-gneiss. Near Grasse lake

Plate 21

To face p. r98

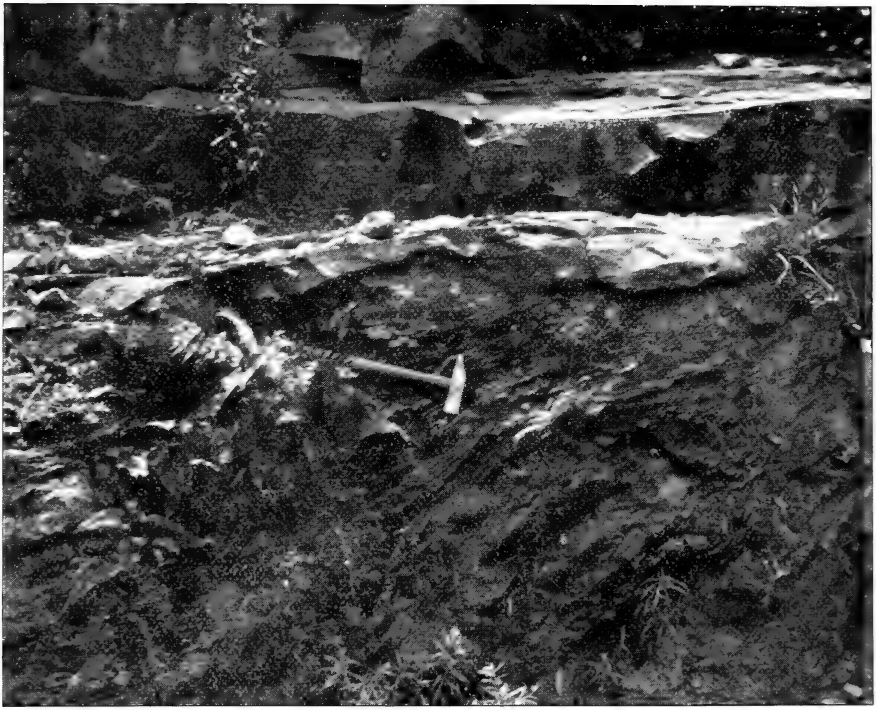


C. H. Smyth jr, photo.

Injection-gneiss. Near Grasse lake

Plate 22

To face p. r99



C. H. Smyth jr, photo.

Unconformity between the Potsdam and schist

Plate 23

To face p. r99

C. H. Smyth jr, photo.

Potsdam conglomerate. Wells island

2 feet, is a conglomerate, with rather small quartz pebbles. Above this the rock has its normal character.

About five miles east of this point and one mile west of Grasse lake there is another contact of a very similar character. The third contact is on Wells island, about one mile east of Thousand Island Park near the road leading to Westminster Park. Here the Potsdam rests on decomposed granite-gneiss or schist and the lower 5 feet of the former is sandstone. Above this is quartz conglomerate, with pebbles ranging up to 6 inches in diameter. Judging from these localities, it is evident that the Potsdam of this vicinity is somewhat different from that farther east where, as Cushing[1] has shown, the lower part of the formation is always a coarse conglomerate and usually red. The latter variety, excepting the red color, is, however, shown at several points on Wells and Grindstone islands, though in no case has it been found in contact with the pre-Cambrian rocks. These localities show a very massive conglomerate, with pebbles ranging up to a foot or more in diameter, the pebbles usually being quite rough and angular. In composition, these pebbles are singularly uniform, as they are with rare exception fragments of quartzite, identical with that of the neighboring ridges, or of vein quartz, such as occurs abundantly all through the pre-Cambrian rocks. Careful search revealed a few small pebbles derived from the tourmalin contact zones described above, indicating a degree of resistance for this rock which is also shown by a general projection of the zones above the surrounding rock surfaces. Not a pebble was found of the granite-gneiss or schist, the conglomerate being thus essentially different from a true basal conglomerate. So far as composition is concerned, the conglomerate is practically identical with the sandstone; both are almost pure quartz, and differ only in grain.

From this very pronounced character of the formation it seems justifiable to conclude that the rocks of the pre-Cambrian land

[1] Potsdam and pre-Cambrian boundary, 16th an. rep't N. Y. state geologist. 1896.

had been so thoroughly weathered that the only coarse fragments available for building conglomerates were purely quartzose the feldspars, ferro-magnesian minerals, etc. having been decomposed.

The finer parts of these residual clays can not now be located; but it is natural to assume that they somewhere formed shales, now buried under later sediments. Some of the clay, too, may have been mingled with the sand, to furnish by more complete decomposition the large amount of silica now seen as secondary quartz cementing the sand grains. But this is a problem which can not be considered at present.

As to the topography of the land surface at the time of the incursion of the Potsdam sea, but one conclusion is indicated by the data at hand, though the evidence is cumulative, rather than conclusive in separate instances. It is a very general rule that, where the Potsdam and the crystallines are shown in close proximity (and such localities are very numerous), the uneven surface of the latter rises at many points far above the base of the former; and, were the flat beds of the Potsdam to be extended, as they once were, they would wrap around these knobs of the crystallines. Again, high ridges of the crystallines often rise to a considerable elevation above the top of adjacent horizontally bedded areas of Potsdam. These latter cases, of course, differ in degree, not in kind, from the foregoing. To account for these phenomena only two explanations are available: either the Potsdam was deposited on a very uneaven surface, or it was deposited on a flat surface, and subsequent faulting has produced the existing relations. The latter explanation would require an immense number of faults, running in every direction, and often with very sinuous courses. As a matter of fact, only one fault, and this a very small one three miles north of Redwood, has been noted, and it is highly improbable that, of the large number required by this explanation, many would not be readily detected.

In some cases, the Potsdam is so nearly in contact with the uneven crystallines that a fault is hardly possible, while in one instance there is a well defined inlier of crystalline in Potsdam, which is of course, so far as it goes, conclusive evidence.

This is on the road running northeast from Alexandria Bay, near the river, and about two miles from the village. In the midst of a flat area of Potsdam the granite-gneiss appears, its surface level with that of the surrounding sandstone, and like it, well smoothed by glaciation. A quarter of a mile northwest, the Potsdam drops away with an abrupt slope down to the gneiss which stretches along the river. The sandstone is horizontal, and about forty feet thick, so that the granite-gneiss now projects up into it this distance, and has lost an unknown upward extension by erosion.

All of these facts taken together render it practically certain that the Potsdam was laid down on an uneven surface of the crystalline rocks.

The same conclusion was drawn by the writer[1] five years ago from study in Gouverneur and Antwerp, but the data then available were much less reliable. Cushing[2] holds the same view for the region studied by him; while Kemp[3] has applied it tentatively to the entire Adirondack region. The writer hesitates to accept the latter generalization till supported by more data than are yet available.

Some years since, Lawson[4] gave reasons for believing that the Cambrian and Silurian rocks of Canada were also deposited on a rolling surface of crystallines. But Crosby[5] has recently described the contact of Potsdam and pre-Cambrian rocks in Colorado, showing that the former were laid down on a nearly plane surface. From this fact, together with the nature of the sandstone, he draws some broad generalizations of much interest and importance.

For the region here under consideration, however, these generalizations do not hold good, since we have a sediment free from arkose and in close proximity to an erosion unconformity, but the unconformity is not, as according to Crosby's hypothesis, it

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[1] 13th an. rep't N. Y. state geologist. 1893. p. 509.

[2] *Op. cit.* p. 6.

[3] Bul. geol. soc. Amer. 8:408-12.

[4] *Ibid.* 1:163–73.

[5] *Ibid.* 10:141-64.

should be, approximately plain and featureless, but quite the reverse.

On the one hand, the uneven surface of the pre-Cambrian rocks indicates a relatively rapid transgression of the sea, too rapid to permit of its reducing the land to a structureless submarine plain. The occasional coarse, poorly assorted conglomerates, with very angular pebbles, also point to the same conclusion. On the other hand, the prevailing homogeneity of the sandstone and the complete absence of arkose suggest slow accumulation and a perfect assorting.

The only satisfactory explanation is that already given—a very complete weathering prior to the submergence; and such weathering, in which chemical changes were dominant, is to be correlated, as Merrill[1] has suggested, with a warm and humid climate. But even with a deeply weathered, superficial layer there must have been, lower down, a zone of partially weathered rocks, which would furnish arkose material, to be disposed of in some way.

To the writer it seems probable that the time required by the sea to cut a plane surface may be much greater than that required under favorable conditions to decompose and disintegrate arkose material, and that thus, while a plain erosion surface ought theoretically to be covered by a purely quartzose sand, an uneven surface may also be covered by such a deposit. Certainly Daubrée's familiar experiment suggests that such decomposition and disintegration must be very rapid under shoal water conditions; while the cutting of a submarine plane must be a very slow process.

The present topography of the region shows, as already stated, a very close dependence on the geology, and varies from point to point, as the underlying rocks change.

A region of schists, limestones and quartzites like that east of Redwood, is very rugged with steep ridges, cliffs, and deep narrow valleys. The maximum relief is moderate, but the irregularity is excessive, being a result of the varied resistance offered

[1]Rocks, rockweathering and soils. p. 283.

C. H. Smyth jr, photo.

Potsdam escarpment. Two miles south of Alexandria bay

to denuding agents by the many different rocks present. Quartzite builds high, steep ridges, the schists more rounding hummocks, while the crystalline limestones are most frequently cut into valleys.

Where, as in the belt just south of the river, the schists occur alone, the topography is less rugged, though still lacking the flowing contours most common in the granite-gneiss. The latter gives a rolling surface, with many dome-like masses, sometimes rising to considerable ridges. Abrupt slopes and cliffs, so common in the schist-limestone regions, are the exception.

The most constant topographic form is, however, presented by the Potsdam. This formation everywhere produces a practically flat surface, terminated on all sides by steep scarps, falling away to the crystalline rocks of the valley bottoms.

All through the region the Potsdam shows numerous beautifully glaciated surfaces, the striations having a northeast and southwest trend. A till, poor in pebbles, is the prevailing glacial deposit. In the valleys it is well developed, and has a pronounced rolling surface. On the uplands it is much thinner. Kame sands and gravels are not abundant.

Of the economic geology of the region there is little to be said. The lead industry of Rossie is of historic interest, and is kept in mind by the beautiful calcites, galenas, and pyrites of the locality, to be seen in every large collection.

At one time the Potsdam sandstone was the basis of a glass industry at Redwood, but today the factory itself is gone. The large furnace plant at Rossie and the site of another near Redwood are the only reminders of an iron industry once of some importance.

On Grindstone island, the granite was worked on a considerable scale a decade since,[1] but today all of the quarries are idle. In view, however, of the excellent quality of stone and the facilities for shipment, it is probable that the industry will be revived at no distant date.

[1] Smock, J. C. Building stone in the state of New York. N. Y. state museum bul. 3. 35–36.

The Potsdam sandstone is quarried on a small scale at many points for local building material. It is also an excellent material for paving stones, and, as it forms a long scarp paralleling the railroad in the town of Hammond, it is worked on a considerable scale for this purpose.

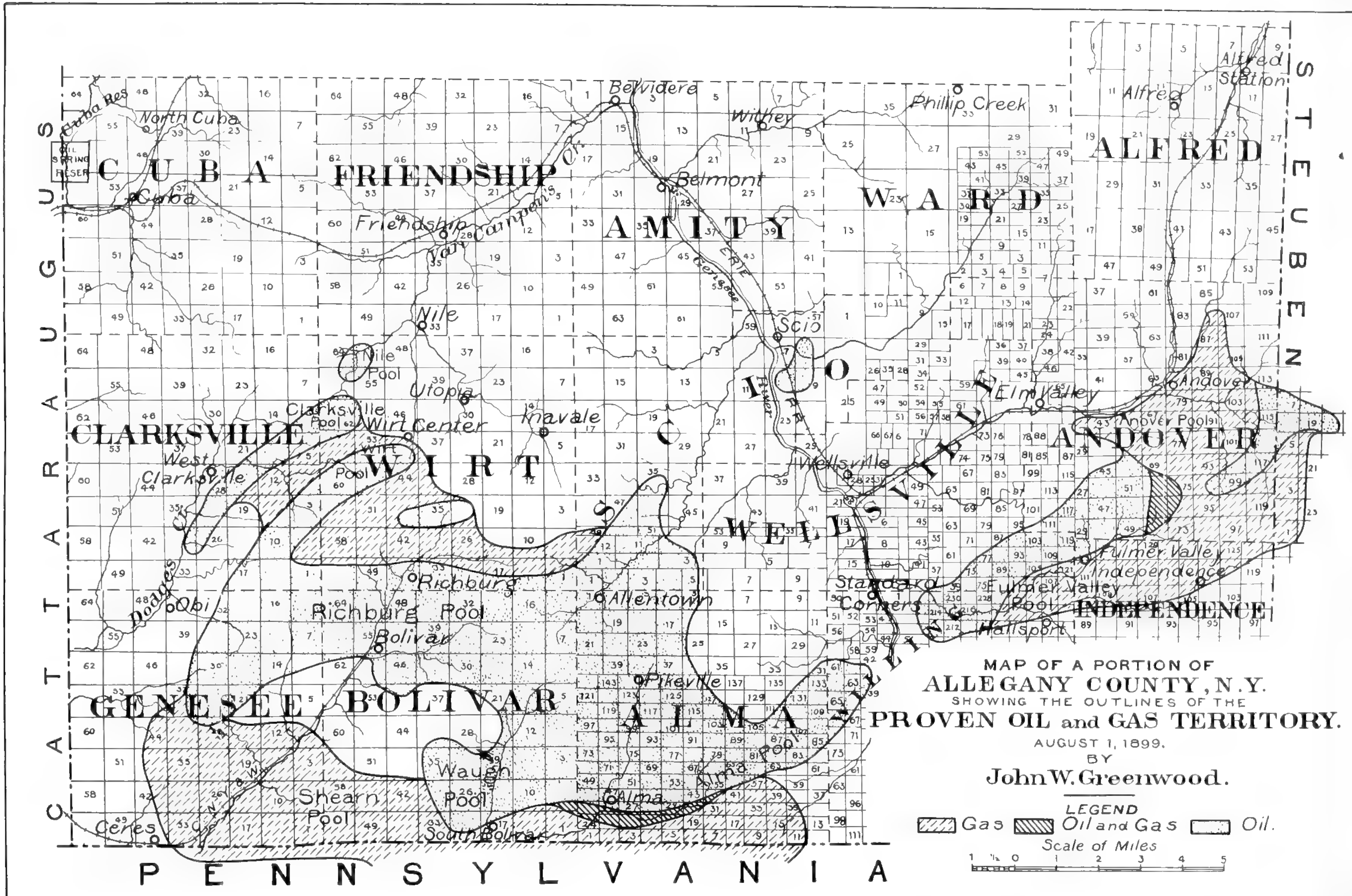
A good deal of the rock is also used for road metal, but as it contains no cementing material, it is not well suited to this use. For ordinary road-building, the crystalline limestone is better, and is used when readily accessible. The same rock is also quarried and burned for lime.

At present, there are no other active mineral industries in the region; and, for the future, it is safe to say that only in the line of building stones is there likely to be any great development.

OIL AND GAS IN SOUTHWESTERN NEW YORK

BY

IRVING P. BISHOP


MAP OF A PORTION OF
ALLEGANY COUNTY, N.Y.
SHOWING THE OUTLINES OF THE
PROVEN OIL and GAS TERRITORY.
AUGUST 1, 1899.
BY
John W. Greenwood.
LEGEND
Gas
Oil and Gas
Oil.
Scale of Miles
1 ½ 0 1 2 3 4 5
CUBA
FRIENDSHIP
AMITY
WARD
ALFRED
SCIO
CLARKSVILLE
WIRT
WELLSVILLE
ANDOVER
INDEPENDENCE
GENESEE
BOLIVAR
ALMA
CATTARAUGUS
STEUBEN
PENNSYLVANIA

Oil and Gas in Southwestern New York

This report is an account of field work done in western New York during the summer of 1899. The purpose of the investigation was to record new developments of natural gas and petroleum in the territory covered by my previous reports and to extend the work as far as possible eastward from Cattaraugus county. For convenience of treatment each county will be considered separately.

Allegany county

The borings for oil and gas in the northern part of this county have yielded nothing of economic value and have added very little to our knowledge of the stratigraphy of the region. In many cases no records have been kept, or when kept are imperfect. The following records gleaned from various sources seem worthy of preservation. The authority for each record is given.

Canaseraga

MR HELMS, DRILLER, WELLSVILLE

A well about 1800 feet deep was drilled about 1880-81. It had a show of gas at 700 or 800 feet. Corniferous limestone was not reached.

Birdsall

H. R. ELLIOT

The firm of Davis & Elliot, Wellsville (N. Y.) drilled this well.

Feet		Feet		Feet
205	Casing	to 205	Top, second pay gas sand	740
65	Top pay gas sand	270	Bottom, second pay gas sand	760
12	Bottom pay gas sand	282	Total depth	800

This well furnished gas enough to run the boiler.

At Shorttract, nearly midway between Hume and Birdsall, a well was sunk about 1885-86, whose record I have not been able to obtain.

Buel well. Hume

A well was drilled in the summer of 1899 on the Buel farm 1 mile west of Hume. The following record is furnished by A. D. Congdon, of Clarksville (N. Y.) driller. Measurements above 1400 feet were taken with a steel tape. Below that the records were by cable measurements.

	Feet	
Soil	35 to	35
Shale without shells or sand	225	260
Shells and slate	20	280
Shale	121	401
Wet sand	1	402
Salt water	13	415
Shale	350	765
Gray sand, even and not hard	10	785
Shale	15	800
Gray sand with a little gas and show of oil	255	1055
Shale with occasional light shell and some gas		at 1055
Soft brown shale	22 to	1177
Soft sand with gas	15	1192
Soft sand	35	1227
Sand mixed with dark shale and show of oil	7	1227
Brown shale without a break	323	1550
Light colored shale	150	1700
Very dark shale	190	1890
Very hard flint rock	35	1925
Light colored shale	20 to	1945
Hard flint	15	1960
Soft, light colored shale	20	1980
Flinty with shells, very hard	22	2002
Dark shale	124	2126
Very dark shale	48	2174
White shale	206	2380
Dark shale with occasional very hard shell	170	2550
Shale and shells, each screw containing some sand	200	2750
Hard gray and brown sand or limestone	90	2840
Clear rock salt	60	2900
Soft, blue and red mixed shale which caved	115	3015
(Salt and shale below it cased off to stop caving)		
Blue and red shales, inclined to cave	311	3326
Stopped in red and blue shales		at 3326

A thin layer of mixed salt and shale was found at 3150 feet. A hard spot occurred between 3015 and 3023 feet. The well was practically barren of gas.

New Hudson

J. FOX, ORAMEL

Two wells have been bored. Well no. 1 had

	Feet
Second sand with gas at about	750
Third sand, 30 feet, with oil, at about	1073
Depth of well	1203

The well was later deepened to 2000 feet without finding more oil or gas. Well no. 2 was drilled in 1882 about 80 rods from no. 1. It was 2000 feet deep and barren.

Belfast

J. D. SWIFT, BELFAST

A well on White creek 4 miles south of Belfast is 1900 feet deep. Gas enough to burn 8 feet high was found at 1100 feet. This was afterward drowned out by salt water. Oil to the extent of a pailful to the boiler was obtained in the third sand. Three wells have also been sunk across the river on Wigwam creek, northwest of the village. Another, sunk in 1898 on the Post farm, is reported to be 900 feet or more deep. Small amounts of gas were found in these, but there is no definite information as to quantity or the horizon at which it was found. Three wells have also been bored at Cuba.

Five wells have been drilled in the township of Rushford, three of which were put down about 1864-65, and the other two about 1883-84. W. W. Bush, of Rushford, furnishes the following record of the upper part of one of these which was drilled to the depth of about 2000 feet.

	Feet	
Drift	4	4
Shale (?)	86	90
Buff sand	38	128
Shell and slate	42	170
Mountain sand (?)	17	187
Shell and slate	415	603
First sand with gas enough for boiler	46	649
Shale	263	911
Second sand	130	1041
Shell and slate (?)	124	1165
Sand and shale	20	1185
Shell, slate, and rotten stone	268	1453

New Hudson, Belfast and Oramel

In the vicinity of Oramel, New Hudson and Belfast are several borings of which no reliable records remain. The following are from memory and at best are only approximate.

Mr Helms, of Wellsville, reports having found Corniferous limestone in one of these wells at 2920 feet. The well was completed, at 3030 feet, in the limestone. A pocket of gas, soon exhausted, was found at 900 feet.

A group of wells at Almond had a good initial pressure of gas but soon ceased to be productive, and were abandoned.

Miner Wellaman states that four test wells were drilled between Cuba and Friendship to the depth of about 1400 feet. They all had a show of oil but not enough to pay.

Several wells have been drilled between Friendship and Belvedere of which no records could be obtained. Mr Higgins, who helped drill some of these, says that two or three had a show of oil at 1000 to 1200 feet in the third sand. One well, 1600 feet deep, was estimated by the drillers to have a possible capacity of three to 15 barrels a day; but, as it has never been utilized, this was probably an over-estimate.

Several borings have been made near Belmont, but no accurate information has been preserved. A well on the farm of Park P. Leilous, 1 mile north of the village is said to be 2800 feet deep, Mr Leilous, however, thinks that it is shallower. The well furnished some oil at 400 or 500 feet and more than enough gas to run the engine.

Another well across the river on the farm of Mr Leilous's brother was drilled to the depth of 1300 feet, producing a little oil and gas. A third well was put down about 100 rods from the Park Leilous well, drawing the oil from its predecessor and leaving it dry. A dry hole is reported on the Tucker farm, and wells of no commercial value on the Bigelow farm, 1½ miles from Belmont, and on Phillips creek, east of Belmont. The last is said to be 1800 feet deep.

Scio

A small oil pool has been developed at what is known as Cow run near Scio. It consists of eight wells with an aggregate production of eight barrels a day. The borings average about 400 feet deep and produce almost no gas.

H. R. Elliot, of Wellsville, furnishes the following facts about a well drilled by Bellamy & Elliott Nov. 6, 1892, at Petrolia, great lot 3, Scio township.

	Feet		Feet
Top chocolate sand	at 1257	Bottom of well	at 1293
Bottom chocolate sand	at 1273		

The well gave an initial production of 25 barrels a day.

Wellsville

Several wells have been sunk in the immediate vicinity of Wellsville, but none of these have been profitable. A well 1000 feet deep on the Bentley farm has about 50 feet of good sand with a small show of gas, oil and salt water at 700 feet. Two wells have been drilled at Riverside, both being unproductive.

H. R. Elliot also furnishes the following record of a well bored for the Adams oil co. on lot 103, Wellsville township, 4 miles southeast of Wellsville.

	Feet		Feet
Conductor	32	Broken sand from 1270 to	1305
Casing	to 476	Second pay oil sand 1305 to	1318
Top gas sand	at 1215	Depth of well	1347
Top oil sand, containing also some gas	at 1258		

The well was shot with 200 quarts of nitroglycerine. At first it produced 35 or 40 barrels, but it soon fell to three.

Well no. 6, Yeager farm

H. R. ELLIOT

Drilled August 1897.

	Feet		Feet
Conductor	32	Top oil sand	1253
Casing	323	Bottom oil sand	1264
Sand	at 1112	Total depth	1302½

Started at 20 to 25 barrels.

Andover gas and oil field

This field lies mostly to the east and southeast of Andover, partly in Allegany and partly in Steuben county. Two producing sands are found, the upper being known as the "Penney" and the lower as the "Fulmer Valley" sand. The lower produces,

in addition to gas, some oil. There are in this field 30 wells, the greater number producing both gas and oil. The first wells drilled gave a confined gas pressure of 400 pounds in four or five minutes. In general, when the gas pressure lessens, the oil begins to enter the well. The output of petroleum has been as high as 70 barrels a day, but in August 1899 it was only 40 barrels a day. The Mutual gas co. limited, controls the gas which is now piped to the villages of Andover, Alfred, Whitesville, Greenwood and Hornellsville. The following well records are furnished by W. J. Penney, of Andover.

Old Brundage well

This, the first successful well drilled in this field, was driven about December 1888.

	Feet		Feet
Casing	280	Bottom of oil sand, 28 ft. thick	718
Gas	at 648	Lower sand	15 feet, to 849
Oil	at 690	Bottom of well	at 1115

Lot 86 Andover

W. J. PENNEY

	Feet		Feet
Drive pipe	65	Gas sand, 15 feet with some oil	at 680
Casing	280		

The gas pressure reached 125 pounds in 6 hours. Total confined rock pressure about 200 pounds.

Well no. 1. Randall Pease farm

W. J. PENNEY

Lot 30. Greenwood township. Elevation approximately 2148 feet A. T.

	Feet		Feet
Conductor	20	(Oil in second sand)	to 898
Casing	320	Bottom of well	925
Second gas sand, 52 feet thick	at 846		

Produced 9 or 10 barrels a day.

Richards well

W. J. PENNEY

Lot 20, Greenwood township. Drilled 1892.

	Feet		Feet
Drive pipe	60	Gray sand and shale	to 777½
Casing	260	Completed	at 814
Gas sand, 24 feet	at 746		

Produced 9 or 10 barrels a day.

Updike well

W. J. PENNEY

East of Andover near county line. Drilled April 4, 1895.

A three barrel well

	Feet		Feet
Drive pipe	40	Bottom of oil sand	654
Casing	330	Bottom of well	688
Oil sand with gas	at 627		

Well records from the principal oil field lying in the southern tier of townships have been published by Ashburner and others. A single one is introduced by way of sample.

Well no. 2, lot 33, Bolivar, Waugh and Porter sands

H. R. ELLIOT

Bellamy & Elliot owners.

	Feet		Feet
Gas sand, 20 feet	at 1341	Bottom oil sand	at 1408½
Oil sand	at 1383½	Total depth	1419

Shot Jan. 22, 1891.

Consumption of natural gas in Allegany and Steuben counties

The Mutual gas co. limited, of Andover obtains its gas from the Andover field, where, as has been stated, it has 30 producing wells. It supplies with fuel and light the villages of Andover, Alfred, Whitesville and Greenwood and Hornellsville in part.

As the gas is sold both by meter and by monthly or yearly contract, it is difficult to estimate with accuracy the total output. Andover, a village of 1000 inhabitants, uses gas to the practical

exclusion of other fuels and illuminants. Alfred has 175 gas connections. Whitesville, 500 inhabitants, and Greenwood, 200, get the greater part of their fuel and light from the same source. At Hornellsville there were, Aug. 1, 1899, between 600 and 700 consumers. The Andover field was at that time adequate to the demands made on it, but was not considered sufficient for the winter. It was expected that the number of connections in Hornellsville would be doubled by the end of the year, and that additional gas would be piped from Potter county (Pa.)

In the remaining portion of Allegany county, lying south of the Erie railroad, the gas is derived partly from oil wells and partly from wells producing nothing but gas. It furnishes fuel for drilling and for private houses on oil and gas leases, the amount of which can not be even approximately estimated.

The principal output is controlled by the following companies.

The supply of the Allegany gas co. limited, main office at Friendship (N. Y.), H. Wilcox agent, comes from Wirt Center. The wells supply both oil and gas, the best supply of gas coming from the fourth sand. The rock pressure is here about 225 pounds, but the flow is so copious that three or four wells are sufficient to supply the line. The company has altogether 600 meters set in Friendship and Belmont.

The Producers gas co., office at Olean, gets its gas from the vicinity of Ceres and the southwestern part of Allegany county. The gas pressure at the wells is from 100 to 200 pounds. This company has 47 connections in Genesee, where the gas is sold through the Empire gas co. The Producers also supplies Portville, East Olean and Westons Mills.

The Empire gas co. supplies Wellsville with light and fuel, the gas for this purpose coming from Pennsylvania. It also supplies Richburg, Bolivar and Allentown from the Allegany field. It has gas connections as follows:

Bolivar	257
Richburg	48
Allentown	52
Total	357

In addition it has about 50 connections on leases and boilers used for pumping and drilling.

The Cuba gas co. of Cuba, gets its gas from wells near Bolivar, Clarksville and Writ. It supplies Cuba village, where it has 650 regular consumers.

A. C. McDonald, of Bolivar, has also a private line from which he supplies his machine shop, the boiler on his leases, about 100 stoves and 200 lights.

Cattaraugus county

The most important development in western New York has occurred at Gowanda[1]. Previous to 1898 three wells had been bored within the village limits.[2]

The first, situated on the Erie county side of Cattaraugus creek and known as the "Frank" well was 860 feet deep, the second, or "Vinton" well, was on the Cattaraugus side near the depot,

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[1]The producing area is nearly all included within a square mile of territory, outside of which, with a single exception, the wells have been barren. Gaenssler & Fisher now have (June 1900) 13 wells, six of which are good. Mr Gaenssler informs me that one gave at the start a flow of 18,000,000 cubic feet a day, and the others run from half a million to 7,000,000 daily. Well no. 6 had a light oil of about the density of naphtha, amounting to about half a barrel a day. The Standard oil co. has drilled four wells on the edges of the Gaenssler & Fisher leases, only one of which was productive. This is located on Broadway, south of the Gaenssler & Fisher wells and overlooking them. The capacity is reported to be one half million feet a day. Michael McIntyre has drilled three wells on the Erie county side of the creek, none of which has produced a large supply of gas, although what there is will be utilized. In the Bader well a small amount of green oil was found, but not enough to pay for pumping. Gaenssler & Fisher are exhibiting a very commendable produce in the control of the gas, having abandoned the use of it under the tannery boilers and shutting it in with the exception of the immediate supply for the village. Under these conditions the wells should supply all the gas the village can use for many years. The community already shows the stimulus of this find in the settlement here of industries using natural gas engines for power and moderate heat, as in a canning factory. The growth in population and general prosperity has been quite marked during the year.

The conditions under which gas is found at Gowanda indicate a reservoir extending from the "Bullhead," or Manlius waterline, up to the

and the third, or "Ross" well, about two miles up the creek near the forks. Both of the south side wells penetrated the Corniferous limestone, and all three had small flows of gas, but not in commercial quantities. In the summer of 1898 Gaenssler & Fisher drilled a well near their tannery between the Vinton and Ross wells. Sep. 23 gas was struck in the Marcellus shale about 25 feet above the tops of the Corniferous limestone, the volume being estimated at 7,000,000 feet a day. After the well had been open several hours, the gage showed a pressure of 650 pounds in one minute, with a total confined rock pressure of 700 pounds. Mar. 31, 1899, the well, while in use, showed a pressure of 650 pounds.

Gaenssler & Fisher's second well, drilled later near the preceding, had a confined rock pressure of 650 pounds with an estimated output of 3,000,000 feet a day. The gas horizon in this well was 50 or 60 feet below the top of the Corniferous.

Marcellus shales. The porous nature of the first rock renders it a likely receptacle; but the range of gas horizons, from 150 to 200 feet in vertical hight, indicates extensive fissuring in the Corniferous and underlying limestones and consequent cavities for reservoirs. The conditions here seem favorable for a gas supply lasting through several years. B. F. Whiting, of Springville N. Y., who has been drilling wells near Gowanda, furnishes me the following notes of wells sunk by him, of which he had no complete record.

Well sunk for Gaenssler & Fisher on the Parks farm near Dayton, Cattaraugus co. This passed through 500 feet of drift without striking rock and was then abandoned.

Another well was drilled at Skinner hollow 3½ miles northeast of Cattaraugus. The record held by the gas company gave the depth as 1962 feet, but Mr Whiting thought it was 2160. The well was barren.

The well at Otto, sunk for Mr Richardson, penetrated the Corniferous limestone and was continued 50 feet into the shales below, total depth 2750 feet. Barren.

A well sunk by Mr Whiting at New Oregon, Erie co. also for Mr Richardson, was 2100 feet deep. It was flooded out by salt water after passing through the Corniferous limestone at 2100 feet.

A well was being drilled (June 1900) at Farmersville, 17 miles east of Delevan by John McMann.

[1]For farther account of these wells see the author's papers in reports of the New York state geologist for 1885, 1895 and 1897.

The flow of a third well on the Bates farm was not measured, but was estimated at a million feet a day. In this the gas was found about 100 feet below the base of the Marcellus in the waterlime at the base of the Corniferous. A fourth well, 1800 feet deep, sunk only 250 feet from the first, furnished only enough gas for two stoves. Early in 1899 Gaenssler & Fisher bored another well not far from the first, the pressure in which is said to be from 600 to 750 pounds and the flow of which is estimated as 10,000,000 to 12,000,000 feet in 24 hours. The gas horizon is thought to be the base of the Corniferous limestone.

Gaenssler & Fisher's first well supplies the heat and light for the tannery and glue factory, the supply of gas amounting in March 1899 to 9,000,000 cubic feet. The second well supplies the village of Gowanda with fuel and lights. In March 1899 the Gowanda gas co. had 200 meter connections and sold 2,500,000 cubic feet of gas in that month.

Gaenssler & Fisher have also an artesian well 198 feet deep in drift, from which clear water flows five feet above the top of an eight inch pipe.

On the Erie county side of the creek two new wells have been drilled, and the old Trunk well has been cleaned out and deepened. Of the latter it is reported that it contained oil in greater or less quantity. The well on the Snow lot had an unprofitable show of gas. Michael McIntyre furnishes the following record of the McMillan well near the cemetery.

McMillan well

	Feet		Feet
Drift	20	(Corniferous, 185 to 190 feet thick)	
Casing	196	Show of oil	at 1600
Small show of gas	at 615	Top of Niagara	at 1680
Second gas	at 1110	Total depth	1720
Top of Corniferous	at 1410		

Two other wells have been sunk on the Cattaraugus county side within a half mile of the tannery. One of them was barren, and the other is, at date, unfinished.

At Versailles, in Cattaraugus county, about 6 miles below Gowanda, three or four wells have been sunk without finding much gas. The following records are furnished by the contractor, J. W. Sterns.

Versailles well no. 1

	Feet		Feet
To rock	15	Bottom of Corniferous, at about	1275
Casing	185	Total depth	1383
Top of Corniferous	at 1075		

A small flow of gas was found at 190 feet in shale.

Versailles well no. 2

	Feet		Feet
To rock	42	Top of Corniferous	at 1241
Casing	199	Total depth	1543

A small amount of gas was found at 940 feet in shale.

Two wells have been drilled in Perrysburg. One was barren, the other showed a little gas. One or two barren wells have been drilled between Zoar and Springville. I have not continued the field work in Cattaraugus county outside of the Cattaraugus creek valley. The following information has been obtained from various sources.

Wells have been sunk at South Dayton and at Thornton, but have not been investigated. A deep well was bored during the summer of 1899 near Hinsdale. This was practically barren, though bored to the depth of 1200 feet or more. A small oil pool was developed during 1899 south of Olean on the opposite side of the river. In the Cattaraugus oil field drilling has been very active, being stimulated by the high price of oil. Drilling to the south and west has extended the known limits of the Chipmunk field so as to connect it, in all probability, with the outlying pools on Luna creek, north of Limestone. The field has also been extended slightly to the southeast.

In the Red House gas field the pressure has fallen so that in August 1899 it was barely 20 pounds to the square inch.

During 1899 several wells were drilled in the immediate vicinity of Olean but without finding pay oil or gas. Rudolph Dot-

terweich has put down two wells between Second and Third streets near the river within the city limits, and a third across the river on the Finn farm. No accurate record of these have been kept. Mr Dotterweich informs me that the Finn well record was:

	Feet		Feet
Stray sand with show of oil	at 385	Bottom sand	at 945
Second stray sand with show of oil	at 685	Shale (?)	to 953
Sand with about 1 barrel of oil a day	at 925	Sand	953 to 964
		Bradford sand (?)	at about 1050

A small show of oil was also noticed between 500 and 600 feet in a sand supposed to be Chipmunk.

The wells between Second and Third streets furnished a small quantity of oil estimated at less than a barrel each a day.

In another well owned by Dotterweich & Seaman, on the Seaman farm at South Olean, a white pebble sand 80 feet thick was found at 805 feet from which gas having a pressure of 50 pounds was obtained. The Bradford sand was found in this well at 1417 feet.

W. R. Page, president of the Olean street car co., has a well on the Finn farm which produces about 2 barrels of oil a week. A second well on lot 4, Portville township, about 1 mile southeast of Olean, contained a show of oil and a trifle of gas. Well no. 3 on lot 1, section 6, same township, had a show of oil and gas from the second sand.

A. and J. C. McMurray were in February 1900 sinking a well near the brickyard in the southern part of the city, near the river. At the time of my visit, Feb. 17, the drill had passed through

	Feet		Feet
Drift	288	Sand, with some 18 feet thick oil	657
Water cased off	at 315	Salt water	734
Salt water and a little gas	415		

The well is located ¼ mile north of the Finn well on the opposite side of the river.

The city of Olean is supplied with natural gas by the Keystone natural gas co., which pipes gas here from Pennsylvania.

As elsewhere noted, East Olean is supplied from Ceres and vicinity by the Producers gas co. The latter corporation has 650 subscribers on its line, which also supplies Westons Mills and Portville.

Chautauqua county

At Mayville are three old borings of some extent. That known as the Hershberger well was sunk 17 or 18 years ago to the depth of 1800 feet, but no gas was found. The second or McCormick well, 1275 feet deep, was located north of the village. Gas was found at 1175 feet with an initial shut-in pressure of 190 pounds, which fell to 100 pounds in a few days. The metered output was about 9000 cubic feet a day.

The third or Colton well near the junction of Erie and Water streets, drilled about the same time as the Hershberger well, was at first 900 feet deep. In 1899 the well was cleaned out and drilled to the depth of 1200 feet, when gas was found with a pressure of 450 lb. When bailed out for redrilling, 3½ barrels of fine amber oil were taken. This must have originated above the 900 feet level.

July 30, 1899, a fourth well was being drilled on the Van Cise lot, about a quarter of a mile northwest of the Hershberger well. It was then down 250 feet in drift without having touched bedrock. At Chautauqua point there is an old boring which at one time furnished a small quantity of gas.

A boring was made in the summer of 1899 about one half mile south of the Western New York and Pennsylvania railway station within the village of Mayville. The contractor, G. B. Keith, furnishes the following record.

	Feet
Drift	220
Casing	305
Shale	595
Dark sand smelling of oil	20
Gray shale	100
Brown shale with gas to bottom of well	at 1240

The amount of gas is not reported.

Another well here (no. 1 ?) has been deepened from 1300 feet to 2300 feet, getting a small vein of gas at the latter depth.

Erie county

Certain wells drilled near Gowanda have been described (p. r115) under the heading, Cattaraugus county.

In Erie county some new territory has been developed and the capacity of the old fields slightly increased by the addition of new wells. At Alden one new well 1308 feet deep was sunk in the spring of 1899 and proved to be the largest producer of that group. The Alden natural gas and fuel co. now has 120 meters on its lines. The gas pressure keeps up.[1]

More wells are being drilled with the purpose, it is said, of supplying Lancaster with gas, a franchise for this privilege having been asked.

Since my last report A. J. Richardson has drilled 11 wells between East Aurora and Orchard Park. Of these only six have been producers and they are small. The gas occurs in the white Medina or quartzose sandstone. One well on the Petrie farm had some additional gas in the red Medina. Brine was found in all at the top of the Niagara limestone. The product is piped to East Aurora and Orchard Park, supplying 160 meters in the former and 53 in the latter; 1,083,400 cubic feet were used in East Aurora alone in March 1899. The supply is hardly sufficient to meet the present demand, and the mains are now taking gas from the Standard pipe line.

At North Collins are three wells, two of which have produced a small quantity of gas. This has been piped to the town and supplies a limited number of taps. The original supply of gas has decreased so that a part of the service has been discontinued.

At the State homeopathic hospital, Collins, a well was sunk about 1898 to the depth of 400 feet without getting through the drift. Water was obtained in large quantity. Later another well was drilled for the purpose of obtaining gas and oil. The following record was furnished by George Neher, of Orchard Park.

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[1]The *Buffalo evening news* of Nov. 22, 1899, through its Alden correspondent, reports that the Alden natural gas and fuel co. is laying a two inch pipe line to Akron to help out the gas supply there. The same authority states that a franchise has been granted this company for piping the village of Lancaster.

Collins well

	Feet		Feet
Drift	to 194	Light colored slate	to 50
Blue slate	500	Black slate	70
Light colored slate	150	Shale (?) and sand	20
Black slate	125	Well was drilled	to 1150

Gas was found at the depth of 1106 feet, with a pressure of 350 pounds. The horizon appears to be about that of the Encrinal limestone of the Hamilton group. The same horizon furnishes a small amount of gas in other borings in Erie county.

The supply of gas was estimated by the driller at the start to be about 650,000 cubic feet a day.

The supply has now fallen off to about one fourth of this amount, and is insufficient for the boilers, but is used in the ranges, etc. It is purposed to drill another well near the buildings.

In the vicinity of Zoar and Springville slight additions to the gas territory have been made.

The Springville natural gas co. has drilled two wells, both in the Zoar district. One on the Tallman farm, on the left bank of the creek, was barren. The other, located between the Fry and Elmer White wells (see map in author's paper, Rep't state geol. 1895) struck a good flow of gas in the waterline at the base of the Corniferous. M. McIntyre informs me that the rock pressure was 400 pounds with an estimated daily production of 2,000,000 cubic feet a day.

B. F. Whiting, of Springville, completed a barren well in May 1900. The location was on the Harvey farm 5 miles east of the village. The Corniferous limestone was found at about 2000 feet and had a thickness of 200 feet. Total depth of well 2300 feet.

Michael McIntyre furnishes the following record of a well known as the "Boro" well, drilled in 1899 on the Johnson farm 1½ miles northeast of Collins station and 3 miles northwest of Collins Center.

"Boro" well

	Feet		Feet
Drift	77	Top of Corniferous	at 1282
Casing	176	Second gas	at 1465
Shale gas nearly enough for boiler	at 190	Depth of well	1548

The flow of gas is estimated at 40,000 to 50,000 cubic feet per day and is not utilized. The gas horizon is at the base of the Corniferous.

At North Collins two attempts have been made to supply the village with gas. The first company in the field drilled three wells. No. 1 at the start gave a large flow of gas, which soon dropped to less than one fourth the original amount. Well no. 2 had a smaller amount, and no. 3 was nearly barren. Information regarding the output of gas was refused by one officer of the company, but another told me that the wells supplied the equivalent of 60 families. Inquiry among consumers showed that the supply was barely equal to requirements in very cold weather.

In these wells the Corniferous is reported to occur at 1050 feet and to be from 150 to 200 feet thick. The gas horizon is said to be at the base of the Corniferous.

The Blaisdell oil and gas co. of North Collins put down a test well in 1899 about 80 rods east of the railroad crossing. It was 1250 feet deep and barren.

At Depew four new wells have been added to the two original borings with the purpose of increasing the supply but with indifferent success. The borings range from 1685 to 1700 feet and find a small supply of gas, not in the white Medina, as is usual in this vicinity, but in the Medina shale at about 1685 feet. The gas is piped to Depew and supplies, according to the superintendent, D. M. Dittman, 55 taps and 25 street lamps. The supply of gas is barely sufficient for the present consumers.

Genesee county

In Genesee county very little has been done within the past two years. The Corfu gas co. drilled an additional well in the

summer of 1897, and another in the year following. The production of these is not stated, but they are reported as "doing nicely and as good in August 1899 as when drilled". The Corfu wells are fair producers. A well is being sunk at Darien by persons in Attica and was down 1300 feet Nov. 27, 1899.

Livingston county

In the vicinity of Caledonia the field has been enlarged by five new wells, making a total of eight. The new borings produce from 1000 to 10,000 cubic feet a day. J. C. Tennant, of the Caledonia natural gas co., reports that its pipe line supplies 96 consumers, including the village lighting and waterworks. Five gas engines together develop 120 horse power, which run flour mills, elevators and pumps for the waterworks. The price is 40c a thousand feet.

A small field has also been developed about four or five miles south of Caledonia. Gas is found in the Marcellus shale at its junction with the Corniferous limestone. The wells are from 60 to 70 feet deep and produce from 1000 to 3000 cubic feet a day. The rock here is said to be saturated with oil.

Mr Tennent also reports that the company has recently drilled a well for gas 150 yards southwest of the Retsof salt shaft at Greigsville (N. Y.) The record of the shaft has been published and therefore is not given here. The record from the bottom of the salt at 1140 feet to the top of the Niagara follows.

Greigsville well

	Feet
Shale with interbedded limestone	140
Niagara limestone	at 1280
Bottom of Niagara limestone	at 1485
(Upper and lower parts of Niagara are soft)	
Clinton shales and limestone	1580
Medina sandstone	1625 to 1748
[First 10 or 15 feet white solid]	
Red shale	1748 to 1800
Bottom of well	at 1800

The upper half of the Medina sandstone was of poor quality, being mixed with blue and green shales. The lower half was

solid and firm, ending in about five feet of pure sand. This is probably the most easterly point at which the quartzose or white Medina has been found. The well was barren of gas; but a black sulphur water was found at 1315 feet in the Niagara limestone, where sulphur gas usually occurs. The record is specially interesting for the reason that this is the only well in the salt district which has gone below the bottom of the Salina.

Onondaga county

Since January 1898, several wells have been bored in the vicinity of Syracuse, concerning which Charles Loccard, manager of the Empire portland cement co., has furnished the following information.

We drilled one well across the road from our factory, and got a flow of gas in the Trenton rock at a depth of about 2500 feet. This giving out after one winter's use, we drilled through to the granite at the depth of 3600 feet, but, as we found no gas, the well was abandoned. About a mile west, on the Sherwood farm, we then drove a second well, which gave a small flow of gas in the Trenton; but, drilling it through to the Potsdam sandstone, we found a fair supply at the depth of 3580 feet, which we are still using. Hoping to better this well, it was shot with 200 quarts of nitroglycerin, but the flow was not increased.

The third well drilled was on the Franklin farm about three fourths of a mile west of the Sherwood well, finding gas in the Trenton with an initial pressure of 1500 pounds a square inch. The pressure rapidly fell, however, after we began using the gas. We are now utilizing the gas from these two wells in offices and in the boiler house.

Though we can not state how many cubic feet of gas the wells are producing, we do not consider them paying investments, and have consequently given up explorations. The wells in this vicinity have a high initial pressure but small volume. If we stop using our wells they soon show a high pressure, which on using decreases very rapidly.

An attempt to confine the gas in the Franklin well at first resulted in blowing out 1300 feet of casing. In the Sherwood well the Trenton limestone was 900 feet thick and the Potsdam sandstone 75.

At the time of my visit July 1, 1899, the assistant superintendent of the cement company estimated the fuel value of the gas used at the works as equivalent to four or five tons of coal a day.

The following record of the Snow well near Memphis was furnished by the driller, H. M. Crawford.

	Feet		Feet
Shale	300	Medina	1300 to 2200
Niagara (?) limestone	100 to 400	Black (Utica?) shale to Trenton	400 to 2600
Shale to Medina sandstone	500 to 900	Best gas horizon	at 2700

Enough gas to run the boiler was found in the Medina. Total confined gas pressure, 1200 lb.

The Jordan, Elbridge and Skaneateles heat and light co., of Jordan, has bored three wells between Memphis and Jordan. Well no. 1 was 3100 feet deep. Medina was found at a depth of 900 feet with confined gas pressure of 825 pounds. Well no. 2, near Memphis, gave a flow of 100,000 feet of gas a day in the Medina and pay gas 90 feet below top of Trenton. The following record of well no. 3 was furnished by the superintendent, G. E. Southard.

	Feet		Feet
Drift	60	Black (Utica?) shale to top of Trenton	at 2585
Red and blue shale and limestone shells to top of the Medina	at 885	Heavy flow of gas soon exhausted	at 2675
Bottom of Medina	at 2235	Pay gas	at 2905
Hard limestone shells and sand	100 to 2335	Bottom of well	3068

At present (Nov. 1, 1899) the company is supplying 150 taps, the greater part of the gas coming from well no. 2. Mr Southard reports that the gas pressure holds up well, but that he can tell better about the supply after some months' test. The gas is now piped to Jordan and Elbridge.

Ontario county

Records from Walter Wellman, Friendship (N. Y.)

In Ontario county, several wells have been bored during 1898-99. One was drilled to the Medina and gave a natural flow of 120,000 cubic feet in 24 hours, with a confined rock pressure of 557 pounds. Another on the Curran Bros.' farm near Allens Hill gave no gas but struck 60 feet of solid white salt at the depth of 1300 feet. A well was being drilled in this field in August 1899.

Schuyler county

The officials of the Glen salt co., at Watkins, refused information regarding their wells. From an employee I learned that no gas was found. Here the salt is over 200 feet thick.

In 1898 a well was started in the middle of the delta at Watkins by another company of which John Clute is manager. This well was sunk to the depth of 1100 feet without reaching the bottom of the drift and was abandoned. The same company was in August 1899 drilling another well on the west side of the outlet near the Northern central railroad depot. At the time of my visit in August it was down 800 feet in rock.

A third well is being drilled by Daniel Campbell, on the eastern side of the delta. The facts furnished by him are as follows.

The well was started near bed rock.

	Feet
Soft limestone 40 feet thick	at 210
Shale	to 1230
Limestone and sand with pyrite	20 to 1250
Black lower Marcellus	at 1310
Sand and lime mixed 240 feet thick	to 1680
Slate 15 feet thick	to 1695
Limestone 20 feet thick	to 1715

In slate at 1715 feet at time of my visit. The sample at 1310 feet had the characteristics of the lower Marcellus, being black, oily and bituminous. The sample taken at 1350 feet was white, clean quartz sand, hard and compact. Gas with a pressure of 100 to 110 pounds was found in this. The sample taken at 1440 feet was hard drab limestone.

Gas also occurs in the well at the sanitarium, of which note was made in Petroleum and natural gas in western New York. (*See* 17th Rep't state geol. 1897; 51st Rep't N. Y. state museum)

Seneca county

At Seneca Falls no wells have been drilled since 1897.

Steuben county

The wells in the southwestern part of Steuben county, in the vicinity of Greenwood, have been described (p. r112) with those of Allegany county, as they naturally fall within the Andover field, by far the greater part of which lies in that county.

In the northern part of Steuben county several test wells have been sunk at different times without producing gas in commercially profitable quantities. In the old Stony brook glen well sunk near Dansville, in 1882, gas was reported at 295 and 508 feet respectively, yielding in 1885, 2500 cubic feet a day.[1]

Another well near Dansville, belonging to the Dansville oil, gas and mining co., was 2240 feet deep. No gas was reported.[2]

A well was sunk previous to 1884 at Bloods on the Delaware, Lackawanna & Western railroad. It was 1495 feet deep with only a showing of gas.[1]

At Prattsburg two wells have been bored, one located 1½ miles southwest of the village and the other 2½ miles northwest. Charles H. Early furnishes the following facts.

Well on Merritt farm 1½ miles from Prattsburg

		Feet
Soil 40 feet thick		
Shale 4 feet thick		
Gray-blue sandstone (?) with occasional hard places	to	60
Red or brown stone	at	60
Gas sand, 8 feet thick followed by salt water		280
followed by salt water		
Gray rock to second sand	at	720
Second sand		10
Third sand, 25 feet thick	at	1067
Black shale to		1800

The third sand was close, highly impregnated with petroleum.

J. G. Arnold, an officer of the company, reports enough gas in the first sand to run the engine. A smaller flow was found in the

[1] *See* Bishop. Salt fields of western New York. Rep't state geol. 1885.

[2] *See* Chart of salt well and shaft sections in New York state mus. bul. 11. Ap. 1893.

second sand, while the third sand had a little amber oil, which accumulated to the amount of about a barrel in four or five days.

Well no. 2 was 1200 feet deep.

At the Pleasant Valley wine cellars, Rheims, one deep and two shallow wells have been sunk for water. The deep well was drilled to the depth of 2000 feet but furnished barely enough gas to burn. The record is lost.

A test well was sunk on the Smith farm half a mile south of Bath in the summer of 1882. This well is said by Ashburner[1] to have been 2050 feet deep. Jacob Rauber, of Wellsville, reports it to have been 2012 feet deep. Little gas was found. During the past year (1899) a large area of land near Bath has been leased, on which other wells will be drilled.

At Lavona a deep boring was made in 1898-99, which appears to have passed below the top of Corniferous limestone. Vincent & Storms of Allentown (N. Y.) have furnished the following.

Lavona well

	Feet
Shales and thin sandstone	to 1527
Brown sandstone with gas enough for the boiler	1527 to 1944
Hard flint sand	at 1944
Brown shell 10 feet thick	
Flint shell, 6 or 8 feet	at 2460
Black shale, Marcellus (?) 40 feet	to 2862
Corniferous limestone (?)	at 2862
Total depth	3005

The last two screws were white sand in which brine occurred, filling the hole and running over the top.

It is probable that the white sand was the Oriskany and that the 143 feet immediately above belonged in the Helderberg—Corniferous group.

A little gas was found at 120 feet before the casing was put in, but none was found afterward.

A well was being drilled at Harvard by J. Rauber, of Wellsville, in August 1899.

The Corning fuel and heating co., F. D. Kingsbury, president, drove a well near Corning in the latter part of 1899. The drillers

[1]Ashburner. Petroleum and natural gas in New York. 1882. p. 54.

were Vincent & Storms, of Allentown (N. Y.) J. A. Vincent furnished the following record.

	Feet			Feet	
Gas		180	Brown shale	12 to	2492
Casing		228	Flint and lime	320	2812
(?)	1071 to	1229	White slate	40	2852
Shale	22	1527	Black shale	10	2862
Brown shale	11	1538	Flint, very hard		130
Brown sand	402	1940	(Corniferous)		2992
Brown shale	8	1948	Lime and white sand	8	3000
Flint	532	2480			

The drill stopped in very white sand.

At about 2992 the drill encountered a white sandstone which is probably the Oriskany. Salt water entered and filled the hole to the depth of 900 feet and stopped farther drilling. No gas worth utilizing was encountered anywhere in the well.

The Page & Darrin well is located on lot 19, Smith & Bostwick purchase, nearly in the center of Erwin township between Addison and Corning.

Page & Darrin well

Elevation of well mouth 1112 feet A. T.

Record from D. M. Darrin, of Addison.

	Feet		Feet
Sand 4 feet thick with a little gas	at 1086	Shale 40 feet	to 1130
		Sand with gas	1148

Of the last, 11 feet was gray gas-sand.

At the start this well by the Pitot tube test indicated a volume of 210,000 cubic feet a day. 10 days after opening, the gage showed a pressure of 110 pounds.

In the vicinity of Hornellsville five wells have been drilled to the same geologic horizon. Three of these, known respectively as the Richardson, Hart, and Big Creek wells, were 1500 feet deep. The fourth, known as the Terry well, was located on higher ground and had a total depth of 2200 feet. William Richardson, of Hornellsville, furnishes the following facts about his well. "At a depth of 700 feet we struck a good vein of gas and at 1250 another of about the same amount and quality. No additional gas was found down to 1506 feet. An expert, testing the well about a week after we finished it, found that it flowed

about a million feet in 20 hours, but this soon fell to about 300 feet a day, which has continued up to the present."[1]

The Hart well, southeast of the village near the glove factory, had a similar supply of gas at approximately the same depth. The Big Creek well furnished only enough to supply a farm house. The deep Terry well was barren. The well at the sanitarium had a small flow of gas which was quickly drowned out by water.

At Canisteo and southward along Bennetts creek and its tributaries several borings have been made within the past 20 years. Of these no authentic records remain. From drillers and others data have been collected which, though not accurate, possess some historic value in that they comprise what is now remembered of these borings. Michael Lynch, driller and contractor, of Andover (N. Y.) furnishes from memory the following record of the well drilled on the D. C. Thomas farm, Canisteo, about 1893.

	Feet		Feet
First sand	at about 300	Third	at 600
Second	at 500	Fourth Sand (held oil)	at 800

The oil, a sample of which is still preserved, is nearly white and of such a quality that it could be burned in the street lamps. The output was estimated at half a barrel a day.

The well at Purdy creek, about half a mile south of Canisteo gave, according to Mr Lynch:

	Feet		Feet
Gas and a little oil	at 800	Total depth of well	1300

This gas supplied eight or ten stoves.

A well at Hartsville shows some oil and a fair supply of gas. Two wells on the Bassett farm, 4 miles south of Canisteo, supplied thirty or forty subscribers, but gave out after two or three months. In one well a pocket of gas was found at 500 feet, which blew the tools from the well. A second streak of gas was found at 700 feet. The well was finished at 735 feet.

At Rock Run, between Canisteo and Hornellsville, there are several wells reported to be about 1300 feet deep, at which depth enough gas was found to run the boiler.

[1]Aug. 17, 1899. The Richardson well was piped to several houses, supplying a moderate amount for five or six months.

The Standard oil co. drilled a well at Cameron Mills about 1880 which at first gave a fair volume of gas but soon gave only enough for one house.

At Wileysville, in the southwestern part of the county, is a well of which Mr Lynch furnishes the following record.

	Feet
First sand with a little gas	at 600
Second sand, brown, 35 feet thick	at 1000
Third sand, brown, 100 feet thick	at 1300
Total depth	2010

Near Spring Mills, a short distance westward in Allegany county, a well was drilled to a depth of 1635 feet, about the year 1893, and furnished gas enough for one stove.

J. W. Darrin of Addison, furnishes the following.

Two wells have been bored at Rexville, one 1635 feet and the other 1181 feet deep. A little gas and about half a barrel of oil a day were found in both. In well no. 2 the gas and oil horizon was reached at 1110 feet.

At Troupsburg, on lot 82, 2 miles from the state line, is a well of which the following is a record.

Troupsburg well

	Feet
Drift	70
Gray sand, 20 feet	at 240
Shale and salt water	at 260
Gray sand giving good gas for two days	506
Gray sand	628
Drill stopped 4 feet in sand	632

The gas pressure rose to 200 pounds in $4\frac{1}{2}$ minutes, the maximum pressure reaching 250 pounds.

A boring known as the Dodge well was made in 1891 near the south line of Hornby township at an elevation of 1191 A. T. A brown sand 20 feet thick was found at 1528 feet. Gas from this sand burned 20 feet above the top of the well.

A well was being drilled Aug. 1, 1899, on lot 9, Campbell township. At that time it had passed through:

	Feet
Drift	5
Chocolate sand	at 115
Gray sand	230

The drill had sunk to 2800 feet without finding gas.

Tioga county

Jacob Rauber, of Wellsville, states that a well was put down at West Candor about 12 years ago. It was 1200 feet deep and barren.

Wayne county

2 miles south of Lyons a well was begun Mar. 9, 1899, and completed early in the spring. No complete record of the well has been obtained but the following facts were furnished by J. W. Stearns, the contractor, and by Dr Veeder, of Lyons.

	Feet		Feet
Drift	30	Sulphur gas in Niagara	at 540
Red and blue marlytes	to 262	Red Medina	at 960 or 980
Cased off flowing brine	at 262	Oswego sand	at 2032
Lower red shale at about	400	Well completed in black (Utica?) slate	at 2340
Top of Niagara (?) at about	480 or 500		

This record is approximately correct. No gas of value was found.

Wyoming county

The Attica field has been enlarged by the addition of several new wells. C. B. & L. Benedict have now five wells and are supplying 75 taps. F. C. Stevens has increased the number of his wells to nine, all within a radius of a mile, and is now at work on the tenth. The wells are at present supplying 275 taps.

At Bliss a well at one time furnished quite a supply of gas and is still reported as producing. The following record occurs in *Bulletin of N. Y. state museum*, 1893, v. 3, no. 1.

Bliss well

R. D. WHITE

Altitude of well 1729 A. T.

	Feet		Feet
Soil	at 55	Black and white shale	286
First gas sand	580 to 620	Flint (Corniferous?)	100
Rock	525	Lime rock and flint, solid	800
Second gas and oil sand	100	Salt, very fine	56
Shale and black rock	400	Lime rock, solid, to bottom	at 2956
Third gas sand	14		

Yates county

Two borings have been made at Penn Yan near the outlet of Lake Keuka. John T. Andrews furnished the following memoranda of a well drilled for him about 1893. It was started on the Genesee shale a short distance above the Tully limestone.

	Feet		Feet
First layer of salt 90 feet thick	at 1200	Second layer of salt 35 feet thick	
Then shales		Depth of well	2053

The well furnished gas but not enough to utilize.

At the Fox and Curtis mill another boring, 400 feet deep, furnished enough gas to run the mill for several months and still yields enough to heat one or two houses.

Two miles from the lake outlet Mr May has sunk a receiver over a vent in the bottom of the canal, from which he has obtained, for several years, surface gas enough for his kitchen range.

At Dundee a boring, of which I was unable to obtain a record, was made several years ago and is said to have passed through salt.[1]

The accompanying map, showing the distribution of petroleum and natural gas in southern Allegany county, has been prepared by Prof. John W. Greenwood, assistant teacher of science in the Masten Park high school, Buffalo, whose long residence in the petroleum region has specially fitted him for this work.

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[1]For note on the Dundee well, *see* Chart of salt well and shaft sections in New York. N. Y. state mus. Bull. 11.

ROOFING SLATE QUARRIES OF WASHINGTON COUNTY

EMERY MINES OF WESTCHESTER COUNTY

BY

J. N. NEVIUS

Roofing Slate Quarries of Washington County

Most descriptions of this region state that the slate belt is divided by the quarrymen into four parallel ranges as follows: East Whitehall red slates, the Mettowee, or North Bend red slate, the purple, green and variegated slates of Middle Granville, and the Granville red slates.

While this classification is of assistance in studying the region, it is not descriptive of the present conditions, for the following reasons: the East Whitehall (Hatch hill quarries) have been extended southward till now, the most important of them are in Granville township; the Mettowee, or North Bend quarries are at present idle, one new opening being the only active representative of this range; the red slate quarries north of Granville, are now idle, and several new ones are operated intermittently south of that village, and several large quarries are not included in this classification.

At present most of the quarries are located irregularly along a north and south line which extends from the Hampton varicolored quarries on the north, and includes the North Bend, the Middle Granville, the red quarries north and south of Granville and the Slateville red and green quarries; then, bending slightly westward, it extends through the purple and green quarries of Salem, Shushan and Cambridge. The East Whitehall (Hatch hill) quarries are west of the northern end of this belt. They are situated 6 miles southeast of Whitehall and 4 miles southwest of Hampton and are partly in Whitehall, partly in Granville townships. The continuation of the red slate, south of these quarries, can be traced, by means of outcrops and openings, nearly to the Mettowee river, but no red slate is exposed in the rock walls of that stream.

The most northerly outcrop of the Hatch hill red slate crosses the Whitehall road about one half mile north of the quarries, where two narrow beds of red slate, surrounded by green, cross the road diagonally. This point is $2\frac{1}{2}$ miles north of the most

southerly exposure. This bed is not the one that is worked at the Hatch hill quarries; for the direction of the strike of the outcrop would carry this bed a quarter of a mile, or more, west of the quarries. The outcrops of red slate on the road to Truthville, ¾ of a mile southwest of the quarries, are probably in this bed. A few small openings have been made on this stratum just north of the Whitehall road, on the Van Falkenbury farm, and have exposed of a very fair quality of slate. The cleavage dip[1] is 30° e 15 s.

The bed on which the quarries are located can be traced several hundred yards north of them. It outcrops in the road and, farther on, it appears in the side of a low hill for a considerable distance. It is probably not more than one hundred or two hundred yards in width, though it is impossible to estimate its width with accuracy. One quarry owner says that the red slate belt is 30 miles in length and 65 rods in width at Hatch hill. Possibly it is, but there is no evidence on the surface to justify such a statement.

The Hatch hill quarries are located in a slight depression, along an approximately straight line ¾ of a mile in length, which follows the direction of the cleavage strike s 8° w. Plate 26 is a general view of these quarries taken from the north. The continuation of the red slate is below the camera on the right; in the foreground is green slate overlying the red.

There are 10 quarry openings in this group, only three of which were being operated in the fall of 1898. Beginning at the northern end, the quarries are as follows.

Hatch hill quarries

No.				
1	I. Herbert	idle	40′ square	
2	"	"	"	
3	National red slate co.	active	100′ x 65′	
4	I. Herbert	idle	50′ square	
5	R. A. Hall	active	240′ x 40′	
6	"	idle	60′ x 50′	
7	Flaherty & O'Brien	active	90′ x 60′	70′ deep
8	Thorn	idle	50′ x 40′	sidehill
9	New opening		10′ x 6′	
10	Baker red slate co.	"	40′ x 20′	

[1]All directions of dip and strike refer to the magnetic north.

Plate 26

To face p. r138

J. N. Nevius, photo.

Hatch Hill red slate belt from the north

J. N. Nevius, photo.

National red slate co.'s quarry, Hatch Hill. Herbert's quarries in background

Plate 28

To face p. r139

J. N. Nevius, photo.

South end R. A. Hall's red slate quarry, Hatch Hill

The average strike of the cleavage in the quarries is 8° w, being s 5° w in nos. 1, 3 and 5, s 7° w in nos. 2, 4, and 6, and s 12° w in nos. 7, 8, 9 and 10. The dip varies from 45° to 55° e.

Plate 27 is a view of quarry no. 3. It is about 90′ deep, and on the west side the cleavage surface forms a smooth wall. The dip is steeper at the top than at the bottom, giving the wall a concave surface. This is due to the slate being so folded in the bottom of the quarry that the workable deposit, which is about 2′ in thickness, is doubled. This fold explains the variation in the dip and strike noticeable in the quarries. New machinery was being installed, and this quarry was being prepared for working on an extensive scale.

The greater part of quarry no. 5 was filled with water, which was being pumped out, but it was being operated at the south end on the hillside. Plate 28 shows this part of the quarry and indicates the warped condition of the cleavage surfaces, which gives the variation to the dip and strike. In this quarry 16′ of slate has to be stripped before workable material is reached, as, near the surface, the slate is hard, imperfect in cleavage and streaked with green. The quality of the slate improves as greater depth is reached.

The amount of waste material in quarrying is enormous. There is a great amount of stripping to be done before workable slate is reached, and the blasting ruins much good material. In the methods of quarrying employed, the waste rock must be hoisted out of the quarry and dumped, as well as the good material and this dead work goes far to consume the profits of the industry.

In the smaller quarries the hoisting apparatus consists of a small derrick operated by a horse or by a team. In the larger quarries it is an apparatus designed for the purpose, which consists of a stationary, two inch wire cable, one end of which is anchored above the quarry and which inclines upward across the quarry, passes over a mast and is anchored in the ground. On this cable hangs a traveler which carries a smaller hoisting cable, one end of which is attached to the winding drum, that is oper-

ated by an engine, while the other end carrying a hook reaches down into the quarry. When the winding drum is released, the traveler runs down the cable, and, when it is at the nearest point to the object to be removed from the quarry, the drum is stopped for a moment and the weight of the slack hoisting cable, hanging between the traveler and the mast, automatically locks the traveler on the stationary cable at that point. Then the drum is released again and the end of the hoisting cable descends into the quarry and is attached to the load to be removed. A bell wire runs from the quarry to the engine house, so that the movements of the winding drum can be controlled by the quarrymen. The load rises till it strikes a lever attached to the traveler, which, when moved upward, releases the clamp that locks the traveler to the stationary cable, and the traveler and load move up the cable to the dumping point near the mast. The waste rock is thrown on the dump, which forms an enormous pile about the mast, and the workable slate is loaded into hand cars and pushed to the trimming shed, where it is split by hand into slabs of the required thickness for roofing slates. These slabs are trimmed to the proper sizes by a foot power machine, which consists of a pair of revolving blades resembling the blades of a lawn mower. Another type of trimming machine resembles a great pair of shears, of which one blade is stationary and the other is moved by foot power.

The slates are trimmed to certain definite sizes, as large a size as is possible being made from each slab. Since the larger sizes are more difficult to procure, they command a much higher price than the smaller ones.

In this quarry (no. 5) the best methods are employed, and besides the roofing material much mill stock is quarried for tiles. These are cut at a water power mill operated by Mr Hall at Truthville, 2½ miles south of his quarries, (*see* plate 29) where he also grinds refuse red and green slate to make the red and olive slate flours, used in the manufacture of oilcloths and also as pigments.

Plate 29

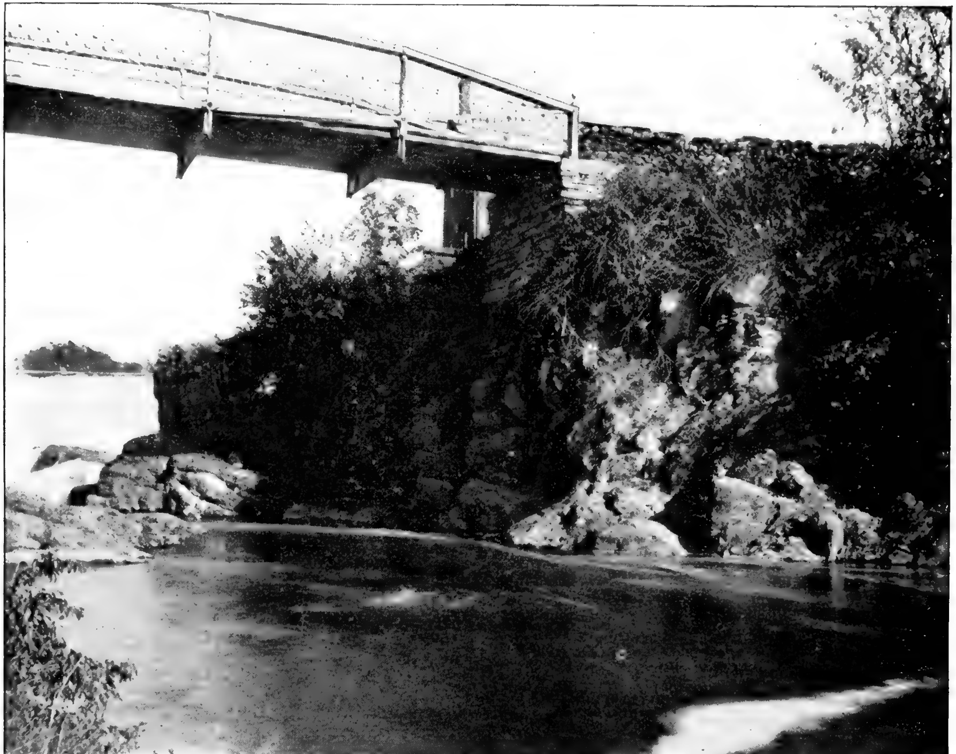
To face p. r140

J. N. Nevius, photo.

R. A. Hall's slate, tile and paint mill, Truthville. Cambrian slate in foreground

Plate 30

To face p. r141



J. N. Nevius, photo.

Mettowee river gorge, Truthville N. Y.

Plate 31

To face p. r141

J. N. Nevius, photo.

Flaherty & O'Brien's red slate quarry at Hatch Hill. Fine quality slate shows well at bottom

The output of this quarry is from 1200 to 1500 squares of roofing slate a year. The Truthville mill cuts from 5000 to 10,000 square feet of tiles a year. These are cut only to order; hence the output is variable. Often much difficulty is experienced in quarrying slabs from which to cut large tiles. From 500 to 800 tons of slate flour are ground each year.

Plate 30 shows the purple and green slate in the gorge of the Mettowee river, in the rear of the mill. No red slate outcrops along this stream.

Quarry no. 7 was the only other one on Hatch hill which was operated in the fall of 1898. It is a small opening, which follows the cleavage dip downward to a depth of about 70 feet and uncovers a thickness of 10 feet of unusually fine slate. Plate 31 shows the interior of this quarry. Before the photograph was taken the workable slate was wetted, and consequently it appears to be of a darker color than the overlying slate, but such is not the case. This quarry is operated by a horse power windlass and employs but a few hands. The output has reached a value of $250 a month.

The dividing line between Whitehall and Granville townships passes through quarry no. 5, so quarries nos. 6-10 are in the latter township.

About a mile north of these quarries is an abandoned opening which exposes the only black slate noticed in this region. It has been idle for several years, and the exposed surfaces show some discoloration due to exposure to the atmosphere. This change, however, is very uniform, and the slate shows an excellent grain and cleavage. It apparently lies between the two red slate beds (if the latter continue so far north), and the cleavage dip and strike correspond approximately with those of the red slate.

On the road between Whitehall and Hampton slate outcrops at several points. The strike of the slate in this region always conforms to the direction of the long axis of the hill of which the slate is a part. It is evident that the slate formation has influenced the topography and has caused the series of oval hills

whose long axes extend in various directions from northwest to northeast.

¾ of a mile southwest of the village of Hampton are located the Potter quarries. There are two of these, the larger of which is several hundred feet in length and shows an enormous amount of work. Both red and green slate occur here, and the cleavage dips 26° e 20° s and strikes s 20° w. These quarries have been idle for some time.

1 mile south-southwest of Hampton are several openings belonging to H. H. Matthews & Co., of Boston. Their main quarry is one of the largest in the region and produces red, unfading green and purple slate of excellent quality. Plate 32 is a view of this quarry, showing the engine house, trimming shed and waste dumps. The methods of quarrying employed are the same as in the other quarries, but here the work appears to be better systemized than at most quarries. The cleavage dip is 30° e 25° s and the strike s 25° w. Several other quarries are located west and northwest of this one (*see* plate 32), some of which are controlled by this company. These are at present idle.

The quarry of the Welsh red slate co. is about 100 rods east of the Matthews quarry. This opening is about 100 feet square and 50 feet deep. The dip and strike are the same as in the Matthews quarry, and the slate, which is all red, is of an excellent quality. The output is sold to the Matthews Co.

The other quarries in this vicinity are idle at present. Some of them are owned by the Anniflan slate co., the Bradley Co. and Hugh Williams.

Southward from Hampton the other slate quarries are scattered for a distance of 15 miles. The majority of them are idle and will probably remain so indefinitely.

At Jamesville, in Granville township, 2 miles south of the Hampton quarries, Jones & Williams quarry an excellent grade of purple, green and variegated[1] slate.

About a mile north-northwest of Raceville are the large quarries operated by the National red slate co., which is a branch of

[1]The word, variegated, is used to designate a mottled green and purple slate.

Plate 32

To face p. r142

J. N. Nevius, photo.

Hampton slate belt. H. H. Mathews's quarries in foreground

the Edwards slate co., of Granville. There are three large openings, in the west wall of which green and banded green and red slate are exposed, while the east walls are all in red. The quarries produce red roofing slate, and are capable of meeting almost any demand that may be made on them. The cleavage dips 40° e 5° s and strikes s 5° w.

¾ of a mile southwest of these quarries are two small abandoned openings for red slate on the farm owned by Mrs M. E. De Kalb. The dip and strike in these openings are the same as in the National quarries, but here the east walls show green slate and the west, red.

These facts indicate that there are two parallel red slate beds here, the National quarries being located on the east bed and the De Kalb quarries on the west one. The latter bed is the one on which the Williams & Allen quarry is located, and the former is probably identical with the bed exposed in the Eagle and the Nixon quarries, described below.

In several quarries red and green banded slate is exposed. This banding is parallel to the cleavage of the slate, and indicates that the cleavage has been developed parallel to the bedding, a condition which is not usual, as the cleavage is formed perpendicular to the direction of the pressure which caused the metamorphism, and this may have been applied at any angle to the plane of bedding.

¾ of a mile south, on the south bank of the Mettowee river, is the Williams & Allen red quarry. This is an opening about 200 by 80 feet in area and 50 feet deep. The workable seam is 20 feet wide, and extends downward along the dip 70 feet, when it loses its valuable qualities. The east wall is green, and the west wall red "bastard" rock, as the non-workable slate is called by the quarrymen. The dip is 42°, n 85° e and the strike is s 5° e. This quarry was opened in May 1898 and produced about 100 squares a month during the summer and autumn. Some of the red layers show ribbon-like markings of a light green color, possibly due to the production by organic remains of acids which prevented, locally, the formation of the peroxid of iron that produces the red color of the slate.

Between this quarry and the De Kalb farm red slate can be traced by outcrops almost continually. A few rods southeast of this quarry and on the same bed are the old "Mettowee or North bend" quarries which are now idle.

1 mile farther south are the quarries of the Penrhyn slate co., which extend along the hillside for three quarters of a mile. Plate 33 is a general view showing a part of this series of quarries. It is taken from a knoll nearly opposite the Middle Granville depot.

These quarries have produced purple, green and variegated roofing material and mill stock, but the company has found it more economic, in the present condition of the market, to procure mill stock in Vermont and to purchase much of its roofing material from the smaller quarries.

Plate 34 is an interior view of the only one of this company's Middle Granville quarries which was producing. The product is purple, green and variegated roofing slate. The cleavage dips 50° e 10° n and strikes s 10° e.

This company operates a large mill adjoining the quarries in which slate washtubs, slabs for lavatories, standards and insulators for electric machinery, tops for billiard tables, tiles, marbleized tiles, etc., are manufactured.

Variegated slate, being one of the cheaper grades, is used for marbleizing. By this process, excellent imitations of various colored marbles, Mexican onyx and other ornamental stones are produced. The coloring is a sort of enamel applied to the slate.

E. Willis, secretary of the company, furnished the following statement of the company's output of roofing slate for the first eight months of 1898.

Penrhyn slate co.'s output of roofing slate, Jan. Aug. 1898

	Red slate	Other colors
Jan.	115 squares	124 squares
Feb.	185	50
Mar.	115	250
Ap.	80	250
May	91	285
June	135	440
July	120	270
Aug.		300

Plate 33

To face p. r144

J. N. Nevius, photo.

The Penrhyn green and purple slate quarries at Middle Granville

Plate 34

To face p. r144

J. N. Nevius, photo.

One of the Penrhyn purple and green slate quarries at Middle Granville

This statement of red slate production includes the combined outputs of the Flaherty and O'Brien quarry at Hatch hill and the two quarries of the National red slate co., which were purchased by the Penrhyn co. Except for the months of January and February, the statement of slate other than red includes the product of the Jones & Williams quarry, at Jamesville, together with that of the Penrhyn quarries.

Near the Penrhyn mill is a small red quarry, located on the same bed as the Mettowee quarries, but now idle.

A mile east of the Penrhyn quarries on the opposite side of the valley are the quarries of the Eagle red slate co. These are the most northerly quarries on (what the quarrymen call) the "Granville and red belt".[1] There are four large openings, but all except the most northerly are idle. This quarry is about 250 by 90 feet in area and 60 feet deep. The cleavage dips 45° e 5° s and strikes s 5° w. The east wall is unfading green slate, and on the west wall, which is a smooth cleavage surface for half the length of the quarry, is a most unique color effect. The upper 25 or 30 feet of this surface is bright red, which gradually changes to the typical unfading green below that depth. A specimen of this material 6 inches long, collected for the museum from the point where the change in color occurs, shows the tendency toward red at one end and green at the other.

Both red and unfading green slates are quarried here in large quantities. The entire output is made into roofing material.

A half mile south of the Eagle quarries are those of the Nixon red slate co., now owned by E. J. Johnson & Co. There are three openings, the largest of which is about 250 by 100 feet in area. The cleavage dip is 36° e 10° s and the strike is s 10° w. Both red and unfading green roofing slates are quarried. The large quarry was operated during the summer of 1898, but shut down in the fall, owing, it is said, to financial difficulties.

South of the Nixon quarries and north of the village of Granville are the two red quarries of the Empire red slate co., and one belonging to Andrew Norton. These are idle.

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[1]See p. r137.

Thomas Williams operates a small red quarry 1 mile south of Granville. Plate 35 is a view of this quarry. The cleavage dips 40° e 20° s and strikes s 20° w. Considerable of the waste material from this quarry is used on the local roads. Slate is too soft and brittle to be a good road metal and has to be frequently renewed, but it packs to a smooth, hard surface, and most of the best roads about Granville are of this material.

A mile south of the Williams quarry are two small openings in the red slate. One of these on F. Sweet's farm is new, and, though the cut is scarcely 10 feet deep, a number of squares of excellent red slate have been produced. The cleavage dip is 38° e 7° s and the strike is s 7° w. This opening is within a few rods of the Vermont line, and it is a curious fact that no trace of red slate has been found in that state.

The old Dennison quarry, nearly opposite West Pawlet (Vt.), which is now idle, shows the strike of the slate to be about the same as in the Williams and the Sweet quarries. The change in direction of the strike just south of Granville is indicated in the topography by a similar change in direction of the long axes of the hills. The westward trend of the slate belt carries the red slate west of the Granville meridian, and it outcrops in the village of Slateville, township of Hebron. The quarries of the Manhattan red slate co. are located here, and they mark the southern limit of the red slate industry. The cleavage dip is 32° e 7° s and the strike is s 7° w. The quarries are large and well located, and the stock on hand is of exceptionally uniform color and grain. Apparently, this is one of the most advantageous quarry sites in the region, but it is idle, because, it is said, of lack of capital to start with after the late business depression, which greatly affected the slate industry in this region.

Roofing material from this quarry was awarded first premium at the centennial exposition at Philadelphia in 1876.

There is a smaller red quarry a few hundred rods north of the Manhattan quarries, which is also idle. 1 mile north of South Granville is another small red quarry which is idle.

Plate 35

To face p. r146

J. N. Nevius, photo.

Thomas Williams's red slate quarry, south of Granville

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To face p. r146

J. N. Nevius, photo.

Thomas Williams's red slate quarry, south of Granville

Plate 36

To face p. r147

J. N. Nevius, photo.

Excelsior purple slate quarry, Salem

1 mile northeast of Slateville, J. J. McDonough has opened a new quarry for unfading green roofing slate. It is well located on a steep hillside, and is one of the few quarries that are being opened with a view to allowing the water to run out, instead of pumping it out, the usual method. The quarry is small, as yet, but has cut a bed of excellent slate and has already produced a considerable quantity of fine roofing material. The cleavage dip is 32° e 9° s and the strike is s 9° w.

From Slateville, southward for 20 or 25 miles, nearly to Hoosick are scattered abandoned quarries. In nearly all of them purple, green and variegated slate are exposed, but much of it is of a poor quality. A few miles north of Salem, and in that township, are the Black creek valley quarries and those of the Excelsior slate co. Johnson's *History of Washington county* states that in 1877 the Excelsior co. shipped $12,000 worth of slate abroad, most of it going to England, Germany, South America and Australia. Plate 36 is a view of one of those quarries partly filled with water.

Near the village of Salem, quarries have been operated by John Dundon, L. M. Macefield, Mrs John Toohe, Charles Johnson and J. M. Williams.

Near the village of Shushan quarries have been operated by Walter S. King and William Dobbin, and a small opening made on the farm of William McGeough.

In all these quarries the cleavage strikes south-southwest and dips at from 30° to 40° east-southeast.

The great number of quarries which are either idle at present or are abandoned is due to several causes. The business stagnation of the past few years closed many of them, and they have not yet been able to start again; others have been located on beds which have proved to be of poor quality or at too great a distance from shipping points; and the recent extensive introduction of iron and terra cotta roofing materials has greatly damaged the slate industry, particularly in large cities. But the chief cause of failure appears to be the lack of capital properly to push the work, coupled with clumsy methods of quarrying and sharp com-

petition in the market. In the best of slate quarries the proportion of waste rock, that must be removed, to the marketable stock is enormous. This is a constant expense, though the waste could find a limited market for use on the local roads, which would not only be a source of revenue to the quarrymen, but would also cheapen transportation for them. Some of the quarries, particularly in the Hatch hill group, where they are located in a depression, are necessarily open pits which require constant pumping. But many others are located on side hills, where a cut or a tunnel could be cheaply run in from below which would not only drain the quarry but would provide a way for the removal of the slate and the waste by gravity instead of by the slow and expensive method of hoisting now in use. The initial cost of such an outlet would be something of a burden, but this would soon be repaid in an increased output and cheapened quarrying.

The age of the slate deposits is carefully discussed by Prof. T. Nelson Dale in the *19th report of the United States geological survey*, where he points out that the red slates are a part of the Hudson river group, and the others are of Cambrian age.

Sea green slate is typically a Vermont product. It belongs to the Georgia group, the lowest formation of the Cambrian system, and is quarried at many points, particularly between West Pawlet and Poultney. Plate 37 is a distant view of the group of quarries at the former town. It is stated that the sea green slate is confined to Vermont, as closely as the red is confined to New York, though south of Granville they outcrop within half a mile of each other.

The slate formation can be traced southward from Washington county, through Rensselaer, Columbia and Dutchess counties, and is also found in Orange county. Red slate of Hudson river age is exposed in a cut of the New York central railroad near Fishkill. William W. Mather, in *Geology of the first geological district of New York*, p. 420, says, "A range of roofing slate extends from New Lebanon through Canaan, Austerlitz, Hillsdale, Copake, Ancram and Pulvers corners in Northeast. It is believed to be the same as that in which the Hoosick quarries are located. Quar-

Plate 37

To face p. r148

J. N. Nevius, **photo.**

Sea-green slate quarries at West Pawlet Vt. (R. R. in slate line)

ries of roof slate have been opened in this range of rocks in many places. The most important are those in New Lebanon, about one and a half miles from the springs on the east face of the mountain".

None of these Columbia county quarries are producing now.

The quarries operated in the fall of 1898 were as follows.

Washington county quarries

NAME OF QUARRY	LOCALITY	PRODUCT QUARRIED	COLOR OF PRODUCT
National red slate co.	Hatch hill	roofing slate	red
R. A. Hall	"	roofing slate, tiles	flour red (and olive flour)
Flaherty & O'Brien	"	roofing slate	red
H. H. Matthews & Co.	Hampton	"	red, unfading green and purple
Welsh red slate co.	"	"	red
Jones & Williams	Jamesville	"	unfading green, purple and variegated
National red slate co.	Raceville	"	red
Williams & Allen	N. of Middle Granville	"	"
Penrhyn slate co.	Middle Granville	"	unfading green, purple and variegated
Eagle red slate co.	"	"	red and unfading green
Nixon red slate co.	"	"	red and unfading green
Thomas Williams	Granville	"	red
F. Sweet	"	"	"
J. J. McDonough	Slateville	"	unfading green

Red slate is the most expensive, the others following in this order: purple, unfading green, sea green, (from Vermont), and variegated. The prices of all grades are subject to change from time to time. The following scale of sizes and prices of red roofing slate were in use during 1898: sizes 20 x 10, 18 x 10, 18 x 9, 16 x 10, 16 x 9, 14 x 9, 14 x 8 and 14 x 7, $10.50 a square; 12 x 8 and 12 x 7, $9 a square; 12 x 6, $8.50 a square; 10 x 6, 10 x 7 and 10 x 8, $6.50 a square.

The color of red slate is as nearly unchangeable as anything can be, showing no perceptible change after years of exposure

to the sun and atmosphere. The sea green slate fades unevenly; after a year's exposure as many as six different shades of color appear. The other colors all fade somewhat, but, if the slates are well matched, the change of color is fairly uniform and passes unnoticed.

[1] "A specimen of the red roofing slate of Washington county was tested and found to have a specific gravity of 2.84, equivalent to a weight of 177 pounds a cubic foot. It contained 1.87% of ferrous oxid, and 7.36% of ferric oxid. Its absorptive percentage was .15. It lost .07% in weight in the sulfuric acid solution test. It remained unchanged in tests of alternate freezing and thawing."

[1] Smock, J: C. Building stone in New York. N. Y. state mus. Bul. 10. v. 2. p. 281.

EMERY MINES OF WESTCHESTER COUNTY

BY

J. N. NEVIUS

Plate 38

To face p. r153

J. N. Nevius, photo.

The Tanite Co.'s emery mine, southeast of Peekskill

Plate 39

To face p. r153

J. N. Nevius, photo.

The Tanite Co.'s emery mine, southeast of Peekskill

Plate 40

To face p. r153

J. N. Nevius, photo.

Upper emery mine on farm of I. McCoy, southeast of Peekskill. Jackson mills emery co. of Easton Pa.

To face p. r153

J. N. Nevius, photo.

Lower emery mine on farm of I. McCoy, southeast of Peekskill. Jackson mills emery co. of Easton Pa.

Emery Mines of Westchester County

A visit to the emery mines southeast of Peekskill, was made by the writer May 9, 1899.

The locality first visited was that of the abandoned mines southeast of Dickerson pond. About five years ago some emery was mined there, but the mine was too inaccessible and was soon abandoned.

These openings were made originally by the Grant iron co., for iron ore. Old iron mines of this company are scattered from this point southward to Colabaugh pond. Mines of other companies are also scattered through this region. The Croton iron co. still claims the right to control all mineral properties on the south side of Nash mountain.

Some years ago an emery mill was operated at Peekskill by Mr St Clair, who mined a few hundred tons of emery on the Bugbee farm, about three miles west of Peekskill. After running for a year or two, the mine was abandoned, and the plant was removed to Oscawana to be near a new source of emery. A new mill was built here, but not long operated. Another company then purchased the mill, but before operations had begun it was burned. It has never been rebuilt. The supply of emery for this mill came from the south side of Nash mountain.

At present the entire emery region is under the control of two companies, that have leased the mineral rights on all farms in the district.

The Tanite co., of Stroudsburg (Pa.) controls the mineral rights on the greater part of the district and mines at several points.

The Jackson Mills emery co., of Easton (Pa.) controls the mineral rights on the farm of I. McCoy, which is situated in the heart of the emery belt and contains several extensive deposits. This is about the only property which is not controlled by the Tanite co.

At the time that iron was mined in this region, the emery was not recognized, and it is stated that it caused much trouble in the blast furnaces on account of its infusibility. It was evidently mistaken for iron, and charged into the furnaces.

The emery outcrops on the hillsides, hence the mines are shallow openings or quarries.

Paleontology

Publications. The state paleontologist reports that, of the work left unfinished at the death of Prof. James Hall, the late state geologist and paleontologist, whose uncompleted work he has been directed to prepare for publication, volume 2 of the 15th annual report of the state geologist and also the 16th annual report are now completed and printed. The memoir on the *Palaeozoic reticulate sponges*, which constitutes a part of the reports above mentioned and is accompanied by 70 lithographic plates, is also completed, and of this memoir a separate edition has been provided for. All of these reports have now been delivered. The memoir on the *Genera of the Paleozoic corals* has progressed as rapidly as circumstances have permitted. The 17th report of the state geologist is now in press, and the 18th, or that for the last year of Prof. Hall's administration, is completed and awaits printing.

The paleontologist has issued two University handbooks, number 13, *Paleontology*, and number 15, a *Guide to excursions in the fossiliferous rocks of New York state.* The demand for these handbooks has been a gratifying evidence of the interest in this field of knowledge. There is also in press a bulletin, *Petroleum and natural gas in New York,* by Dr Edward Orton, one, the *Lower Silurian system of eastern Montgomery county,* prepared by Professors C. S. Prosser and E. R. Cumings, and another by the paleontologist comprising a number of scientific papers. All of these are communicated with this report. There is, farther, communicated herewith the manuscript of a memoir entitled the *Lower Oriskany fauna of Becraft mountain, Columbia county,* by the paleontologist.

Additions to the collection. The acquisitions by donation, collection, purchase and exchange have been considerable and important. Among these are 24 type specimens of sponges and brachiopods, and of the remainder, 450 have been donated and several thousand specimens collected. Of the important material added by collection a considerable amount is of very

superior quality, and will complete the museum collections in many important lines heretofore unsatisfactorily represented. This is specially true of the material from the earlier faunas collected in the Lake Champlain basin.

A valuable acquisition by purchase is a collection of about 1000 specimens representing heretofore unknown Crustacea from the base of the Salina formation, Monroe county, from C. J. Sarle, of Rochester. The department has also received, from Prof. A. L. Arey, of Rochester, the promise of a series of fossils representing an undescribed fauna from the layers at the top of the Niagara group.

Work on the collection. Dr Rudolf Ruedemann, having passed the necessary examination, was appointed assistant to the paleontologist and began his term of service March 1. Since that date a card catalogue of the type specimens of fossils in the museum has been inaugurated in continuation of similar lists prepared by the writer some years ago. This important work has progressed well, and already shows that the state museum possesses far more of this valuable material than it has been credited with.

The work of revision of the entire paleontologic collections, the assorting of the material and the separation and labeling of the superior grade of specimens as a permanent reserve for the museum collection has progressed satisfactorily. The purpose of this protracted but much needed work is to get together into one synoptic collection all the material that will be serviceable to the museum for the exhibition of the paleontologic wealth of the state, and to eliminate the large amount of inferior and to some degree worthless material from the collections as a whole which is the residuum from many years of indiscriminate selection. The paleontologic collection also contains an important number of casts of type specimens either in plaster or gutta percha, the originals of which have been figured in the publications of the state, but which now belong to other institutions. Experience has shown that these replicas become injured or

totally destroyed with time; and hence the experiment of electrotyping such casts has been undertaken with complete success.

The old manuscript record of localities of fossils begun 40 years ago had become so overcrowded that the preparation of an entirely new record seemed imperative. This work has been completed, and a copy of the new record, covering about 2000 localities for the paleontologic specimens in the museum, is herewith communicated for publication. Its usefulness to the students of paleontology generally, rests in the fact that it is the most complete list yet prepared of the fossiliferous localities of this state.

Research. During the year the scientific investigations of the paleontologist have been carried forward as other duties permitted. Subjects of special consideration and study have been the following:

The character of the newly discovered Lower Oriskany fauna of Columbia county

The undescribed Portage fauna of Erie and Chautauqua counties

The line of separation of the Lower Helderberg group from the strata and faunas beneath it, and the plane of division between the Silurian and Devonian systems

The composition and origin of the fauna of isolated limestone lenses occurring in the Clinton and Niagara groups of Orleans and Niagara counties

The stratigraphy and contents of the Lower Silurian rocks in the Lake Champlain region

The correlation of the "Hudson river group" of the upper Hudson valley

Mineralogy

In mineralogy the following important pieces of work were accomplished with an expenditure of much careful labor on the part of J. N. Nevius, assistant: relabeling and rearranging the general mineral collection; relabeling and rearranging the collection of gems.

Ethnology

In ethnology material progress has been made in relabeling and rearranging the collection of Indian relics purchased under the supervision of A. G. Richmond. This work was done under my direction by J. N. Nevius, who, after completing the arrangement of the new material so far as possible, completed the transfer of the Indian relics for many years exhibited on the third floor of Geological hall, to the new cases in the corridor of the fourth floor of the capitol.

General zoology

The work of the museum in Geological hall for the past fiscal year has been marked by several new and important features. Among the principal of these should be mentioned the work of Dr Marcus S. Farr, who was temporarily employed in December 1898 and formally appointed assistant in zoology, after a competitive civil service examination, in July 1899.

In the work of the department Dr Farr's energies have been devoted almost exclusively to the care of the collections of vertebrate zoology. His first work was in preparing for exhibition the material gathered by Dr Tarleton H. Bean, who during the preceding field season was occupied in making a collection of fishes of New York in the waters of Long Island. As this collection had been left for several months in weak alcohol, several changes and filtrations of the preservative were necessary before the jars were ready to be placed in the cases. 86 species are here represented,[1] all New York forms, forming a very interesting and attractive exhibit and materially supplementing the earlier collections of fishes. Altogether 190 species are now represented in our collections exclusive of foreign species. Owing to the fact that little systematic work had been done in vertebrate zoology for some time, all the collections needed careful attention.

The bird collection has been very carefully studied. All the identifications have been verified and some few corrected. A card catalogue of the entire collection has been prepared, showing a

[1] *See* 52d an. rep't N. Y. state mus. p. r12.

total of 1038 individuals, representing 426 species. Of these 353 are North American; the others are foreign forms. New York state forms are represented by 325 species. The preparation of this catalogue has entailed a great amount of labor, as all the old records and reports have been searched; and all the available data concerning each individual specimen appear on the card assigned to this specimen. In some few cases the data are incomplete, as seemingly no record of time and locality of capture was kept of the earlier specimens in the collection. The birds have all been renumbered. A number is placed on the pedestal on which the specimen is mounted and a corresponding number on the label, so that it is almost absolutely impossible for a label to be misplaced. The nomenclature has been thoroughly revised to conform to the latest supplements to the A. O. U. check list, and the collection has been rearranged systematically. As far as possible the data concerning those specimens actually taken in New York state appear on the label.

The collection of mammals has likewise been very carefully studied, and all the specimens have been reidentified. A new and neater form of label has been devised, and the collection has all been relabeled, the nomenclature conforming to the latest literature on the subject. Of the 81 forms accredited to the fauna of New York state, 56 are represented in our exhibit. A card catalogue of this collection has also been prepared.

The old collection of fishes has also received its share of attention. The labels have been very carefully revised, so that all now conform to the nomenclature in Jordan and Evermann's *Fishes of middle and North America*. A new series of labels has been written, and the alcohol on those forms preserved in spirits has been either filtered or changed. A card catalogue of this class of vertebrates is now almost complete.

A collection of birds eggs illustrating the range of variation in size among the eggs of living birds has been arranged. 39 species are represented in the graduated series, ranging in size from the African ostrich to the ruby-throated hummingbird. This forms an interesting and pleasing exhibit.

All the collections of vertebrate zoology have been rearranged, and the present arrangement is deemed to be as attractive as possible with the limited space now available.

In all his work the curator has been hampered by lack of space for the exhibits. All the cases are so overcrowded that, with the exception of the bird collection, it is not possible to arrange the different classes of vertebrates systematically. Many of the exhibits should be considerably augmented. This would be specially true of the collection of birds eggs and nests if more space were available, but, under the existing conditions, this increase would be possible only at the expense of some of the other exhibits, which would have to be stored. Moreover a large amount of interesting material already belonging to the museum can not now be placed on exhibition for lack of space. All the cases have been cleaned and the specimens carefully dusted. Quite a little work has been done in the way of repairing specimens, which it is not possible to note in detail.

A new and very attractive office has been built for the use of the assistant zoologist on the northwest corner of the third floor of the museum, and this is conveniently near the collections of vertebrate zoology which are on the floor above. A room in the basement has been assigned to the department for use as a zoologic laboratory, and this also affords space for the storage of glassware, alcoholics, etc.

As a result of the limited appropriations for museum work, the duties of the assistant zoologist during the year have been those of a general curator, and but little time has been available for original investigations. However, the work is now well under way, and the coming year will present opportunities to pursue field investigations, to increase materially our collection of New York state forms, to prepare a guide to the study of the collections, etc.

During the year William L. Mulcahy, who has been employed in the capacity of junior clerk, has rendered valuable assistance in preparing labels and in general office work when not otherwise engaged.

Publications

In the field of publication, Gerrit S. Miller jr, after completing the preliminary list of New York mammals reported last year, prepared an important contribution to science entitled a *Key to the land mammals of northeastern North America.* This will be of much aid to students in zoology in determining the species with which they meet.

Dr Tarleton H. Bean is occupied with the preparation of a report on the fishes of New York, which will supplement the corresponding publication of De Kay's, as did, in the branch of mammalogy, the former bulletin of Gerrit S. Miller jr.

Entomology

In the state entomologist's report for 1899, the introductory part mentions some of the more important insects observed during the year and makes several recommendations.

Under notes on injurious insects, the relative abundance, the destructiveness or the distribution of the following insects is given: Raspberry saw fly, Monophadnoides rubi; locust borer, Cyllene robiniae; elm leaf beetle, Galerucella luteola; asparagus beetles, Crioceris asparagi, C. 12-punctata; willow butterfly, Euvanessa antiopa; forest tent-caterpillar, Clisiocampa disstria; 17 year cicada, Cicada septendecim and Drepanosiphum acerifolii. Also results obtained in comparative tests on the elm leaf beetle of paris green, London purple, paragrene and arsenate of lead, and on the forest tent-caterpillar of paris green and arsenate of lead.

Under voluntary entomologic service of New York state is given a brief history of the organization and abstracts, arranged by counties, from all the more important reports.

That part of the report devoted to the exhibition of insects at agricultural gatherings shows the advantage of exhibiting such collections, the popular interest in them which is manifested, and

gives several extracts from press notices. Catalogues were distributed in connection with the collection. This catalogue gives the more important characteristics of over 80 species of economic importance, and outlines the methods of controlling the injurious forms. It has been reprinted.

The list of publications of the entomologist gives the title, place and date of appearance, and abstracts of the 95 publications of the entomologist during the year. The report of contributions to the collection includes the scientific and common name of the insect and the names and addresses of the senders.

Botany

The report of the state botanist for the year 1899 contains in its introductory part some comments on the meteorologic character of the season and its influence on the growth of fleshy fungi, a list of the names of the species of which specimens have been collected and added to the herbarium, a list of the names of those who have contributed specimens and the names of the species of which they have respectively contributed specimens, remarks concerning species now reported for the first time as a part of our state flora, together with descriptions of such as are deemed new or hitherto undescribed, also remarks and observations on many species previously reported. It contains also a list of the flowering plants and ferns found on the low and extensive piece of wooded marshy land known as Bonaparte swamp, lying in the northern part of Lewis county and on the east side of Lake Bonaparte. The report closes with descriptions and plates of 11 new species and varieties of fleshy fungi.

That part of the report relating to the 14 species recently tested and added to our edible species is published, with descriptions and illustrations of the 33 species previously reported, as *N. Y. state museum memoir 4*. There are 25 plates, 24 devoted to the illustration of edible species and one to an unwholesome species.

Physiography

The collection of relief maps has been increased by the addition of one of the eastern part of the Adirondack wilderness and another representing the vicinity of Syracuse, which is intended to be used in illustrating the geology of the salt deposits.

There is also in preparation for exhibition at the Pan-American exposition at Buffalo a relief map of Niagara falls and vicinity.

Attendance at the museum 1 Oct. 1898—30 Sep. 1899

Total	55 529
Monthly maximum, August	7 026
Daily maximum, Feb. 21	493
Average, monthly	4 627
Average, daily	182

The following is a comparison of the turnstile records for the past six years, showing the averages of yearly, monthly and daily attendance.

	AVERAGE		
	YEARLY	MONTHLY	DAILY
1 Oct. 1893—30 Sep. 1894	72 185	6 015	233
1 Oct. 1894—30 Sep. 1895	61 368	5 114	197
1 Oct. 1895—30 Sep. 1896	52 003	4 333	170
1 Oct. 1896—30 Sep. 1897	53 366	4 447	175
1 Oct. 1897—30 Sep. 1898	54 907	4 575	180
1 Oct. 1898—30 Sep. 1899	55 529	4 627	182

ACCESSIONS TO COLLECTIONS IN GEOLOGICAL HALL

Economic geology

Donations

R. A. Hall, Whitehall N. Y.: Samples of red and olive colored slate flour from Mr Hall's mill at Truthville, Washington co.

Collections

J. N. Nevius: 89 specimens of roofing slate from the towns of Whitehall, Granville, Hampton, Hebron and Salem, Washington co.

Dr Heinrich Ries: 1 specimen sandy clay, Wyandance L. I., used for buff brick; specimens brick clay, J. Ouimet, Plattsburg N. Y.; 1 specimen upper sandy clay, Wyandance L. I.; Champlain clay, J. Ouimet's bank, Plattsburg N. Y.; finest white clay, Kreischer's new bank, Kreischerville S. I.; 2 specimens clay, T. Ryan's bank, Rossville S. I.; 1 specimen clay, Mrs H. McKenzie, Glencove L. I.; 1 specimen hydraulic limestone, Akron cement co., Akron N. Y.; 2 specimens hydraulic limestone, Buffalo N. Y.; 2 specimens dolomite, Lauer & May's quarry, Brighton, near Rochester N. Y.; 5 specimens tufa, Mumford N. Y.; 4 specimens limestone representing the upper bed and 6 the middle bed of Jones's quarry, Chazy N. Y.; 1 specimen limestone, Waterloo N. Y., 1, Union Springs N. Y.; 3 specimens limestone, quarry just being opened at Chazy; 35 small specimens limestone, Clark's quarry, Willsboro N. Y.; 1 specimen partially weathered Medina shale, Lewiston N. Y.; 1 specimen shale, Corning brick and terra cotta co., Corning N. Y., 1, Windom N. Y.; marl, Ithaca N. Y.; marl used by Portland cement co., Perkinsville N. Y.; marl, Simpson's pit near Mumford N. Y.; 1 specimen lower lime layer, 1 specimen upper lime layer and 13 small specimens, Goodrich's quarry, Auburn N. Y.

Structural geology

Donations

Homer Smith: 1 specimen schist altering to serpentine, Tilly Foster iron mine, Putnam county, N. Y.

Historic geology

Donations

Edwin Linton, Washington and Jefferson college, Washington Pa.: 1 specimen upper layer, 1 middle layer and 1 lower layer of upper Washington limestone, Washington Pa.; 1 specimen Sigillaria brardii, "fish bed" of upper Washington limestone 1 mile north of Washington Pa.

Prof. J. J. Stevenson, University of the City of New York: Series of 19 specimens to illustrate Carboniferous and sub-Carboniferous

of Pennsylvania, chiefly from Uniontown and Chestnut Ridge, Fayette county, Pa.

Collections

Edwin C. Eckel: 150 specimens gneiss, quartzite, limestone and mica schist, New York and Westchester counties, N. Y.

Benjamin F. Hill: 193 specimens gneiss, quartzite, limestone and mica schist, Putnam county, N. Y.

Mineralogy

Donations

Dudley Avery, Avery island, New Iberia La.; 1 crystalline aggregate and 4 crystals (1 very large) of rock salt. The deposit is said, by Mr Avery, to be several hundred feet thick and very uniform in quality. The mine supplied the Confederacy during the civil war.

St Patrick's academy, Troy N. Y.: 1 specimen niccolite and franklinite in crystalline limestone, Sangre de Cristo mountains near Silver Cliff, Custer co. Col.

Frank S. Becker, Kinderhook N. Y.: Several specimens graphite, Splitrock, Essex county, N. Y.

Fred H. Bell: 1 specimen petrified wood, Hamilton, Bermudas.

Purchases

Clarence C. Miller: 2 calcite crystals clusters from Howe's cave, Schoharie county, N. Y.

Ethnology

Donations

C. A. Cox: 1 fishing sinker, D. L. Mead's farm, Bethlehem Center, Albany co. N. Y.

Purchases

John W. Sanborn, Franklinville N. Y.: Model of an Iroquois Indian village.

Numerous accessions to this department were made during the year through the activity of A. G. Richmond and Mrs Harriet M. Converse. Among the most important may be enumerated the following: 1 flute, 1 rattle, 1 scalp knife, 1 feather flag, 1 wampum, 1 burden strap, Five Fires wampum belt, Red Jacket wampum belt (fragment), Mary Jamison wampum belt, Cornplanter wampum belt and treaty, Algonquin wampum string, 1 turtle rattle, 1 bone pipe, 1 stone pipe, 1 corn pounder, 2 wooden spoons, 1 wood handle bowl, 1 bread bowl, 1 knife gouge for making masks, 1 gambling bowl, 1 old drum, 1 medicine gourd, 1 old clay pot.

Zoology

MAMMALIA

Donations

M. S. Farr: Skin and skull of armadillo Dasypus minutus Desm., Rio Chico, Patagonia; Baleen plate from whalebone whale Balaenoptera sp., coast of Patagonia.

S. H. Oliver, Glenfield, Lewis co. N. Y.: Opossum Didelphis virginiana Kerr., Greig, Lewis co. N. Y.

Joseph Morje: Brown bat Vespertilio fuscus (Beauvois), Albany N. Y.

Collections

Dr Tarleton H. Bean: 2 specimens shrew, A. P. Latto donor, Southampton N. Y.

M. S. Farr: 2 specimens brown bat Vespertilio fuscus (Beauvois); 2 specimens red bat Lasiurus borealis (Müller), Kenwood, Albany N. Y.

Purchases

P. E. Hering: 1 specimen South American opossum, Aspinwall, U. S. of Colombia; 1 specimen brown bat Vespertilio fuscus (Beauvois), Albany N. Y.

BIRDS

Donations

Mrs W. W. Byington, Albany N. Y.: Mounted group of loons and sandpipers, St Lawrence river.

Miss Annah Arms Cheney, Glens Falls N. Y.: Pine siskin Spinus pinus (Wils.), Glens Falls N. Y.

Miss Bridget Dempsey, Albany N. Y.: American osprey Pandion haliaëtus carolinensis (Gmel.), Albany N. Y.

Collections

M. S. Farr: Screech owl Megascops asio (Linn.); Baltimore oriole Icterus galbula (Linn.), m. and y.; phoebe Sayornis phoebe (Lath.), f.; wood pewee Contopus virens (Linn.), m.; Ovenbird Seiuras aurocapillus (Linn.), m.; American redstart Setophaga ruticilla (Linn.), 2 m., 1 f.; chestnut-sided warbler Dendroica pensylvanica (Linn.), m. and f.; white-breasted nuthatch Sitta canadensis (Lin.), m. and f., Kenwood, Albany, N. Y.

Purchases

George W. Cornell, South Cambridge N. Y.: American bittern Botaurus lentignosus (Montag.), South Cambridge.

BIRDS' EGGS

Donations

M. S. Farr: 6 sets robin Merula migratoria (Linn.); 8 sets catbird Galeoscoptes carolinensis (Linn.); 2 sets brown thrasher Harporhynchus rufus (Linn.); 2 sets kingbird Tyrannus tyrannus (Linn.); 1 set dove Zenaidura macroura (Linn.); 1 set wood thrush Hylocichla mustelina (Gmel); 2 sets grass finch Pooecetes gramineus (Gmel.); 1 set crow Corvus americanus Aud.; 1 set house sparrow Passer domesticus (Linn.); 17 sets red-winged blackbird Agelaius phoeniceus (Linn.), Cranbury N. J. Singles of the following species: 25 house spar-

row **Passer domesticus** (Linn.); 3 quail **Colinus virginianus** (Linn.); 5 northern flicker **Colaptes auratus luteus** Bangs; 2 turkey **Meleagris** (domestic variety); 1 yellow warbler Dendroica aestiva (Gmel.); 3 chipping sparrow Spizella socialis (Wils.); 2 wood thrush Hylocichla mustelina Gmel.; 1 meadow lark Sturnella magna (Linn.); 1 cedar waxwing Ampelis cedrorum (Vieill.); 1 bluebird Sialia sialis (Linn.); 1 house wren Troglodytes aëdon Vieill.; 1 hummingbird (with nest) Trochilus colubris Linn.; 3 phoebe Sayornis phoebe (Lath.); 2 red-winged blackbird Agelaius phoeniceus (Linn.); 2 robin Merula migratoria (Linn.); 2 catbird Galeoscoptes carolinensis (Linn.); 1 crow Corvus americanus Aud.; 2 domestic pigeon Columba livia domestica (Linn.).

Collections

M. S. Farr: Set of 7 eggs northern flicker Colaptes auratus luteus Bangs; set of 5 eggs ovenbird Seiurus aurocapillus Linn.; set of 6 eggs yellow-billed cuckoo Coccyzus americanus (Linn.) (with nest); set of 3 eggs American redstart Setophaga ruticilla (Linn.) (with nest), Kenwood, Albany N. Y.

Purchases

Frank H. Lattin M. D., Albion N. Y.: Singles of the following species: swan Olor (domestic variety); black-billed gull Larus marinus Linn.; gannet Sula bassana (Linn.); Canada goose Branta canadensis (Linn.); great blue heron Ardea herodias Linn.; Farallone cormorant Phalacrocorax dilophus albociliatus Ridgw.; red-shouldered hawk Buteo lineatus (Gmel.); mallard Anas boschas Linn.; marsh hawk Circus hudsonius (Linn.); American coot Fulica americana Gmel.; domestic pigeon Columba livia domestica (Linn.); green heron Ardea virescens Linn.; barn swallow Hirundo erythrogaster (Bodd); wood pewee Contopus virens (Linn.); chickadee Parus atricapillus Linn.

REPTILIA

Collections

Dr Tarleton H. Bean: 3 specimens painted turtle Chrysemys picta (Hermann); 1 specimen garter snake Thamnophis sirtalis (Linn.), Swan river, Patchogue L. I.

Purchases

Mathies Fletcher, Fonda N. Y.: 1 specimen northern rattlesnake Crotalus horridus Linn.

Martin Eagan, Albany N. Y.: 1 specimen alligator Alligator mississippiensis Daudin.

Ward's natural science establishment, Rochester N. Y.: Plaster models of the following species: black snake Bascanion constrictor (Linn.); water snake Tropidonotus sipedon (Linn.); bull snake Pityophis sayi Schlegel; De Kay's snake Storeria dekayi Holbrook.

AMPHIBIA

Purchases

Augustus Rohr: 6 specimens mud puppy Necturus maculatus Raf., Kenwood, Albany N. Y.

Ward's natural science establishment: Plaster models of the following species: tiger salamander Amblystoma tigrinum Green; American toad Bufo americanus Le Conte; dogfish Squalus acanthias Linn.; wolf fish Anarhichas lupus Linn.; garpike Lepisosteus osseus (Linn.); shovel-nose sturgeon Scaphirhynchus platorhynchus (Raf.); lake sturgeon Acipenser rubicundus LeS.; paddlefish Polyodon spathula (Walbaum); maskalonge Lucius masquinongy (Mitch.); rainbow trout Salmo irideus Gibbons; brown trout Salmo fario Linn.; brook trout Salvelinus fontinalis (Mitch.); large-mouthed black bass Micropterus salmoides Lacépède; American eel, Anguilla chrysypa Raf.

Donations

George R. Howell: Piece of pine **wood bored by Teredo** Teredo navalis Linn., **from the coast of New Jersey; 1** specimen of common slug **Limax maximus Linn. Albany N. Y.**

Relief maps

Modeled by **Edwin E. Howell, Washington D. C.: Adirondack** mountains, scale, horizontal and vertical, 1 inch=1 mile; comprising the nine topographic sheets or quadrangles, Willsboro, Ausable, Lake Placid, Mount Marcy, Elizabethtown, Port Henry, Ticonderoga, Paradox lake and Schroon lake.

Syracuse and vicinity, scale, horizontal and vertical, 1 inch=1 mile; comprising the four topographic sheets or quadrangles, Syracuse, Baldwinsville, Skaneateles and Tully.

University of the State of New York

BULLETIN

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Collection, preservation and distribution

OF

NEW YORK INSECTS

BY

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State Entomologist

CONTENTS

PREFACE

The organization of a corps of voluntary observers makes it necessary to issue directions for collecting and shipping insects. It is believed that the chapter on the distribution of insects will be a valuable guide in directing observations along lines hitherto largely ignored. This bulletin has also in view the guidance of pupils who, for a small compensation, may undertake to collect insects for the state. It was thought best to include directions for preserving insects, in order to encourage younger students to build up collections of their own.

No claim is laid to originality in the text of this bulletin, as available sources of information have been freely consulted. The illustrations are all original, having been prepared under my direction by my assistant, Mr C. S. Banks.

EPHRAIM PORTER FELT
State entomologist

COLLECTING INSECTS

With a little experience it is usually easy to collect insects very successfully, provided one gets rid of the notion that the more common forms are unworthy his attention. I have repeatedly seen students who were required to make a collection, spend more time begging insects than it would take to catch them. A beginner must be content at first to take those he can see, and then as eye and muscles become trained, he will soon be able to secure those of greater value.

Collecting bottle. First provide at least a collecting jar or bottle. For most insects, except the larger ones, a wide-mouthed vaseline bottle is very convenient, but certain butterflies, moths and other insects with a considerable wing-spread should be put in a larger bottle or jar with a proportionately wider mouth. In order to prevent specimens from injuring themselves, the jar should be charged with potassium cyanide, but as this is a deadly poison it must be handled with care and the bottles might be more safely prepared by a druggist or teacher. The usual method is to put in the vaseline bottle two or three pieces of cyanide about twice the size of a pea (more if a larger jar is used), pour in just enough water to cover the poison, and then add at once enough plaster of paris to take up the water. With a cloth wipe out the upper portion of the bottle and allow it to stand uncorked till the plaster has hardened and the inside is dry. Then cork tightly, label the bottle **Poison,** and in a few hours it will be ready for use. Do not have the bottle open more than is necessary as the cyanide loses strength rapidly. Those afraid of this dangerous substance can add chloroform to a little cotton kept in place by a disk of blotting paper and use that in the collecting bottle. But as chloroform requires frequent renewal and is not so deadly to insect life, the cyanide bottle is generally preferred, and with reasonable care need not be feared. With no farther outfit many insects can be captured by advancing the open bottle and partly pushing and partly driving the specimen in with the cork. A little

FIG. 1 Collecting bottle (original).

practice will be found necessary before the more wary species can be taken in this manner.

Insect net. Those wishing to secure butterflies, moths and other rapid flying insects will have much use for a net. This may either be bought or made at home. It consists of a stout handle, a broom handle

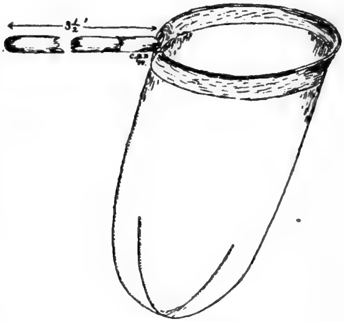

Fig. 2 Butterfly net (original).

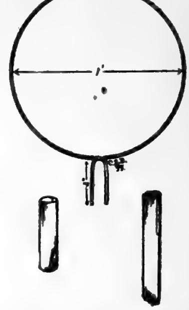

Fig. 3 Details of net rim (original).

about 1 meter ($3\frac{1}{3}$ ft) long will answer, to which is securely fitted a $\frac{1}{2}$ cm ($\frac{3}{16}$ inch) wire ring 30 cm (about 12 in.) in diameter, bent as indicated in figure 3 and firmly held by a ferule. The ring can easily be made and attached by a tinsmith or blacksmith. The net itself should be a little shorter than the collector's arm, preferably of cheese cloth and firmly sewed to a thicker band around the ring. The bottom of the net may be cut square, forming two corners, or better, cut round or into four angles and brought down to a point, as represented in figure 4, thus doing away with corners which are apt to be troublesome. Those wishing a nicer article can buy of dealers in entomologic supplies various styles of nets ranging in price from $1 to $2.50. For $1.50 a very desirable net with jointed handle and folding frame can be secured. When using the net approach the insect cautiously and with a quick swing and turn of the handle it is captured. It does not pay to chase insects. Transfer captures directly from the net to the cyanide bottle, as the less insects are handled the

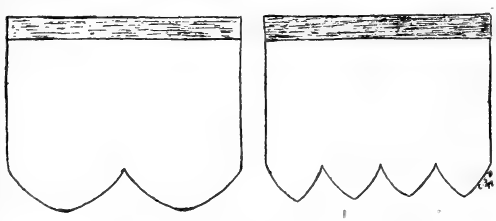

Fig. 4 Patterns for net bottoms (original).

greater their value. Usually it is comparatively easy to place the open bottle over an insect in the net and induce it to enter without touching it.

Those wishing to collect water insects will find a shallow net of coarse material much more convenient than the ordinary butterfly net, because the mesh of the latter is too fine to permit moving it rapidly through the water.

FIG. 5 Dip net (original).

Collecting box. Those interested in butterflies and moths will find a collector's box of great service. This is a flat box just deep enough to hold pinned specimens and having a layer of cork on the bottom. It may be made specially, or a cigar box of convenient size for carrying may be utilized. Some collectors merely attach a short piece of leather with a buttonhole in the free end, and when in the field the box hangs from a convenient button. Others use a strap swung over the shoulder.

Folded papers for butterflies. Butterflies may be killed in the net by pinching the thorax between the fingers, taking care that the wings are folded back before touching the insects. They are then placed in papers as represented in the accompanying diagram, the slip being proportionate to the size of the insect, and the locality and date placed on the outside. Specimens may be sent through the mails without injury in such papers.

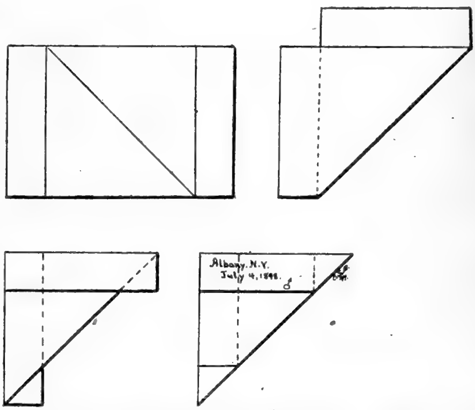

FIG. 6 Method of folding butterfly papers (original).

Vials and small boxes. It is well to carry on a collecting trip a number of vials and small boxes in which insect eggs, larvae, etc., with a little of their food plant, can be kept for closer examination later. For soft bodied insects several of the vials should contain 50% alcohol.

Capturing insects. The beginner will soon learn that certain localities are more productive than others and that the time of day has considerable influence on insect activity. It would be well, though by no means necessary, to take the first trip or two on bright warm days in

company with one who has done some collecting, and plan the course so that diversified country will be traversed. Insects may be found in almost any place, but experience will soon teach the most favorable localities. At first take everything, thus training eye and muscle, and learning a little of the varied forms of life. The collector will soon find that beetles, bugs and other insects can not be put in the same bottle with certain forms without becoming covered with scales, and if ambitious to secure nice specimens, he will have a special bottle for butterflies and moths. Dragon flies are also best kept in a large bottle by themselves. Large insects injure the smaller ones and it will be found that numbers of water insects can not be put in with others without injury to many of the more delicate terrestrial forms. Hence, the necessity of treating collected insects differently, and the immense number of forms to be studied, will soon compel specialization to a certain extent. That is, all those belonging to one order, as the butterflies and moths, the beetles, etc., or those attacking a few related plants or occurring in certain localities will be collected in preference to all others, and in this way many valuable facts are ascertained, which would be impossible were general collecting continued indefinitely, and at the same time much pleasure may be derived from the pursuit.

FIG. 7 Pistol case bearer (original).

The actual method of procedure can hardly be described. In a general way walk rather slowly, pausing to examine a cluster of flowers, to look under stones, to examine the trunk and branches of trees, rotting wood, etc. After a little practice it will be surprising to see how many species on flowers can be taken with nothing but the collecting bottle. Many insects belonging to the bee and wasp family, some very handsome beetles, interesting members of the true bug family and a few flies can be captured in this manner. As some beetles and bugs drop readily to the ground, the bottle should be held a little below the insect. Dark colored, rapid running ground beetles may be found under stones and will require quick work to catch them. Trunks and branches of trees repay a careful examination. On the

FIG. 8 Cocoons of apple Bucculatrix (original).

smoother bark, sometimes hardly visible, there may be scale insects sucking the vital fluids from the tissues beneath, while numerous forms take shelter under loose edges of the rougher bark. Caterpillars of various kinds may be found crawling on the trunk or resting on the smaller twigs and sometimes resembling their support so closely as to require a practised eye to detect them. In winter and early spring the peculiar case bearers, the cocoons of the apple *Bucculatrix*, and the more concealed winter retreats of the bud worm can be found only by close inspection. Then there are the eggs of various species, some times in clusters on the bark or even in belts around the limbs, as in the case of the apple and forest tent caterpillars. Minute particles of sawdust hanging from a slender thread or lying at the base of the trunk indicate the presence of borers. In a similar manner examine the foliage quietly and carefully. Various larvae, some moths, leaf-feeding beetles, bugs, etc. may be found and by holding the net or an inverted umbrella under a bough and beating it with a stick other good specimens can be obtained. When it is remembered that 371 species of insects are known to attack the apple tree or its fruit in one way or another, some idea will be obtained of the possibilities in collecting. Every part of a tree — root, stem and branch, flower, leaf and fruit — will repay examination. A person who will take one plant and study thoroughly the insects occurring thereon throughout the year can hardly avoid making a rich contribution to the world's fund of knowledge.

FIG. 9 Egg belt of apple tent caterpillar, enlarged (original).

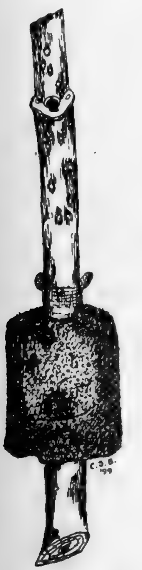

FIG. 10 Egg belt of forest tent caterpillar, showing a few exposed eggs, enlarged (original).

The insects inhabiting a meadow, those living in sandy places, aquatic or alpine forms, all offer inviting fields to the student of nature, and in each the collector will find much of interest. In meadows or grass land and other places where there are not too many obstructions, sweeping with the net results in the capture of many species. The collector advances across the field swinging his net vigorously to one side just above the herbage, or even hitting the taller plants, and at the end of the stroke turns the net quickly and reverses the movement, thus produc-

ing a continuous sweep which is maintained till considerable material is taken. The desirable specimens are then removed from the net and the operation continued. In sandy places the fauna is rather scantily represented by ground beetles, tiger beetles, grasshoppers, etc., requiring closer search to secure many forms. Among the more interesting insects are those inhabiting water. Caddice fly larvae with their peculiar cases may be found at the bottom of streams and ponds; on the under sides of stones the curious larvae of stone flies occur; among weeds and decaying matter the strange water scorpion moves slowly, its long legs and slender body suggesting the walking stick, which is, however, a very different insect. In ascending a mountain a good idea of the effect of climate is obtained by a study of insects. As the altitude increases certain species become less abundant and forms relatively scarce in the lower regions begin to appear in numbers. A striking example of this is seen in the arthemis butterfly, *Basilarchia arthemis* Drury, a northern insect with a range closely limited by the southern boundary of New York state. In the lowlands it is relatively scarce, while in the higher regions near and in the Adirondack and Catskill mountains it abounds on account of the more congenial climate. At a moderate altitude insects are numerous but they differ in species from those below, and at extreme hights the fauna becomes scanty with an increase of wingless species. The latter peculiarity is also noticeable on smaller islands and may be explained by the strong winds of such places carrying away flying insects and thus favoring wingless forms.

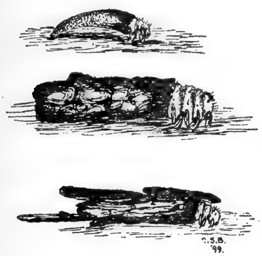

FIG. 11 Caddice fly larvae and cases (original).

Collecting at lights and sugaring. The attraction light has for insects is well known, and is frequently taken advantage of by collectors, who secure valuable specimens in this way. In many places all that is necessary is an open window in a lighted room. Dark, warm nights accompanied by rain are usually the most productive. In cities the electric arc lights attract many insects and may be visited with good results.

Examples of the family Noctuidae or owlet moths (many are known to the farmer in the larval state as destructive cutworms) can probably be secured in no better way than by sugaring. This consists in smearing a mixture of sugar and vinegar on the trunks of a number of trees or on fences in a favorable locality. Stale beer added to a mixture of sugar or molasses and water makes a very effective preparation. The bait is

applied at dusk to a number of places, and each desirable specimen is taken with the aid of a light by placing a wide-mouthed cyanide bottle over it while feeding. The moth will usually enter the bottle at once or can be induced to do so by a slight lateral movement of the poison jar, and then the cork can be replaced. If it is a good night, the collector will need at least two cyanide bottles in order that dead specimens may not be injured by later captures, the moths being transferred to the second jar as they become quiet.

Immature forms. Collecting insects in the pupa or quiescent stage is a ready means of securing perfect adults. Aside from rearing caterpillars, this is the only method of obtaining the more perfect examples of butterflies and moths, and is quite extensively practised. Cocoons may be found hanging from limbs, particularly on the lilac, lying on the ground enveloped in leaves, or securely tucked in many a sheltering crevice of tree, stone and fence. A large number of caterpillars enter the ground to a slight depth and transform in rude earthen cells. It is not difficult to find pupae in the soil, particularly in forests. They can be obtained in large numbers in fields where army worms have been abundant.

FIG. 12 Promethea cocoon on lilac, slightly reduced (original).

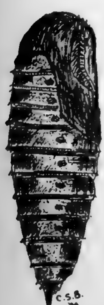

FIG. 13 Pupa of imperial moth (original).

Most collectors pay exclusive attention to the adult insects, and only in the exceptional cases of a few well-known forms are caterpillars considered worth bothering with. As we unfortunately know comparatively few insects in their adolescent stages, this has stood in the way of their study, specially as larvae are rather difficult to preserve nicely and only in the hands of the skilful can be made attractive. Nevertheless the collection and study of immature forms, notably caterpillars, offer a very inviting field to one who delights in the unknown. Their habits, adaptation to conditions, protective coloring, etc., are very interesting and profitable lines for inquiry, and when larvae of all orders are included, the student has before him an exceedingly rich field. It is nearly impossible to find a place in nature that is not capable of supporting insect

larvae. They may be found devouring the entire substance of leaves, eating only the softer under portions or even mining between the upper and lower epidermis. They closely simulate the appearance of a twig, bore within it or the trunk, inhabit all manner of vegetable matter, food stuffs, etc., are found in the alkali lakes of the west and one species is known to live in crude petroleum in the vicinity of oil wells, showing to what a wonderful extent the various forms of life can adapt themselves to conditions.

PRESERVING INSECTS

Most insects can be preserved by pinning and drying, but to attain the best results it will be necessary to have a few supplies and to follow certain tested rules.

Insect pins. Entomologists prefer insect pins made specially for this purpose. Those most extensively used in this country are from 3.5 to about 4 cm ($1\frac{3}{8}$ to $1\frac{5}{8}$ in.) long, are more slender than ordinary pins and are made in several sizes, the more convenient being nos. 1, 3 and 5 of the Kläger pins, no. 3 being the best if but one size is used.

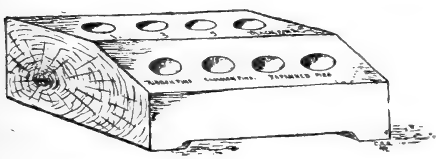

FIG. 14 Block for holding pins (original).

A convenient means of keeping several sizes and kinds of pins is a light block of wood about three fourths as deep as the pins are long with a 2-centimeter (nearly $\frac{1}{2}$ in.) hole for each size of pin. Kläger pins or those of other makes may be obtained from dealers in entomologic supplies. A black japanned pin is preferable to the unprotected or white pin as there is less liability of verdigris spoiling the insect. The trouble with the black pin is found in its lack of stiffness, specially in the smaller sizes.

Pinning block. For the best appearance of the collection the insects should be fixed on the pins at a uniform hight. The beginner can accomplish this most easily by using a pinning block, a small piece of wood with a thickness equal to one fourth the length of the pin and with a hole through it large enough to admit the pin head. When mounting, thrust the pin nearly through the insect and then push it back to its proper place by reversing the specimen and sticking the head of the pin through the hole in the pinning block. If desired, labels and

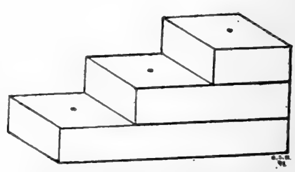

FIG. 15 Pinning block (original).

insects mounted on points can be fixed at uniform hights by using a pinning block composed of three pieces one fourth the length of the pin, and with holes through the center of each step. The lower one can be used for spacing insects and labels, the second one also for labels and the third for small insects on card points.

Rules for pinning. Many entomologists prefer to have about one fourth of the pin above the specimen, and this can be secured easily by using the pinning block described above. Experience has taught that not all insects can be pinned alike with the best results. As a rule the pin is thrust through the middle of the thorax, care being taken to have the insect straight on the pin. Among beetles however this procedure would result in spreading the elytra or wing covers and would produce very unsightly specimens. The rule for this large family is to put the pin through the right elytron or wing cover. Examples of the suborder heteroptera, or the true bug family, are usually pinned through the scutellum, the triangular piece near the base of the wings.

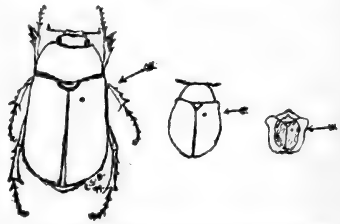

FIG. 16 Method of pinning beetles (original).

FIG. 17 Method of pinning true bugs (original).

Spreading apparatus. Butterflies and moths require some arrangement before they are fit for the cabinet. As taken from the bottle or papers and pinned, the wings are but partially expanded and frequently so folded that but few of the markings can be seen. This is remedied by the spreading board, composed of two boards with a crevice between large enough to admit the body of the insect, and having below the slit a strip of cork through which the pin holding the insect is thrust. The boards and cork are held in place by end and middle pieces. The points of the pins extending through the cork should be protected by a light strip underneath. Spreading boards are made in various styles and sizes to give sufficient room for the body and ample space for the wings. Three very convenient sizes have widths of $4\frac{1}{2}$, 8 and 11 cm ($1\frac{3}{4}$, $3\frac{1}{2}$ and $4\frac{1}{2}$ in.) with body spaces for the insects of 3, 6 and 10 mm ($\frac{1}{8}$, $\frac{1}{4}$ and $\frac{3}{8}$ in.) and have a uniform length of $44\frac{1}{2}$ cm ($17\frac{1}{2}$ in.). Many prefer to have the wings spread exactly horizontal and others insist on a slight upward slant in order to counteract the natural tendency of the wings to droop after the specimens are removed from the boards.

A spreading pin is a great convenience and may be made by twisting with pliers a large beheaded insect pin tightly around and near the point of a large mourning pin in such a manner that the two form a right angle. The mourning pin is stuck into the board at a slight angle so that the smaller pin is held down on the insect's wings like a spring and prevents their flying back after being put in position. Narrow strips of paper held by pins at each end may be used in a similar manner.

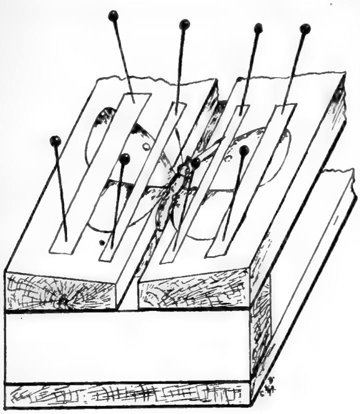

FIG. 18 Portion of a spreading board (original).

Directions for spreading. The pin is pushed through the cork till the wings are on a level with the board and the legs are arranged. Then take a setting needle and bring the wings of one side into position, holding them there either with a spreading pin or a narrow strip of paper. In a similar manner place the wings of the other side, having the posterior margins of the fore wings as nearly as possible on the same straight line, taking special pains to have the wings of each side uniformly advanced. Secure them in place with broad strips of thin cardboard or preferably thin pieces of mica. Arrange the antennae and after the board is full put it away and allow the insects to dry for several days or a week. Another method of spreading requires still less material. The pin sustaining the insect is thrust through the pasteboard bottom of a small inverted box and squares of pasteboard or thin wood of ample size are laid on either side in such a manner as to be of the proper hight. With a needle arrange the wings on the squares of pasteboard so far as possible and hold them in place by laying on small pieces of glass. By tipping up one edge of the glass considerable rearrangement is possible, or by pushing the lower block gently, wings and all may be moved either forward or backward. This method is capable of producing very good

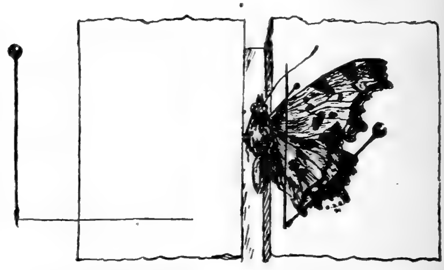

FIG. 19 Spreading pin and method of use (original).

results but the setting board is preferred by many. In spreading butterflies and moths the greatest care must be exercised not to rub off their scales. Members of the bee and wasp family, dragon flies and others are more valuable after spreading and should be so treated when possible.

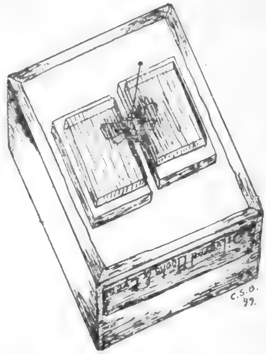

FIG. 20 Moth spread on pasteboard box (original).

Relaxing insects. From one cause or another it frequently occurs that insects become dry and brittle before they can be permanently arranged. In this condition no spreading is possible without serious breakage. If the specimens are put on paper or a piece of cork in a closed jar with moistened sand or a damp sponge and allowed to remain from a day, in the case of very small insects, to several days for the larger forms, they can be spread very well. The specimens should not be left in the jar too long or they may be spoiled by mold. A few drops of carbolic acid will aid in preventing fungus growths.

Denton's tablet. A pretty way of mounting butterflies and moths, specially for display, is in Denton's tablets, which are blocks of plaster of paris with a depression for the body of the insect and with paper strips for hermetically sealing the glass covers. As the glass rests upon the wings, they are held perfectly flat and the cover affords protection from dust and museum pests. Specimens thus mounted are said to be less affected by exposure to light. The tablets are sold at a moderate price and directions are supplied with each lot.

Treatment of small insects. Many insects are too small to be mounted, even on the most slender long pins. One of the easiest ways of caring for minute specimens is to mount them on card points, which are triangular pieces of card, cut either with scissors or with a punch designed for the purpose. An insect pin is thrust through the base of the card point and the specimen attached to its extremity with a little shellac or gum. Or a fine pin may be taken, its head removed, the pin bent to a right angle, the larger end twisted with pliers tightly around a stouter pin near its point and pushed farther up on the supporting pin, and the specimen impaled on the upturned point of the smaller pin. Another way of accomplishing the same end is by cutting off the larger portion of the smaller pin and thrusting the point through a piece of cardboard or firm blotting paper, which in turn is mounted in a similar manner on a

larger pin, and is then ready for the insect. Small species can also be put with labels in gelatine capsules through one end of which a pin is run.

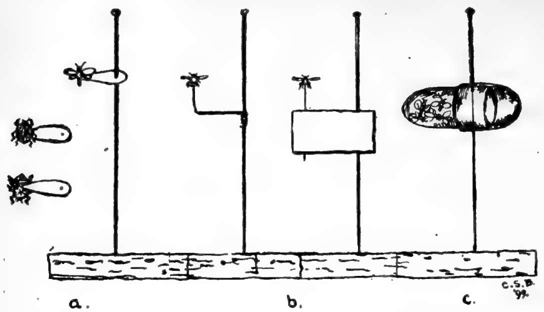

FIG. 21 Mounts for small insects. *a*, on card point; *b*, on pin point; *c*, in a gelatine capsule (original)

The collector frequently secures a large number of very small insects belonging to a single species. It would take much time to mount these as described above and yet they should not be thrown away, because such material may be desirable for later study. They may be preserved in alcohol or placed in vials and allowed to dry before corking in order to prevent mold. In a similar manner very desirable material taken at one time may be stored under a common label till there is leisure to arrange it, as the specimens have only to be relaxed before final mounting.

Inflating larvae. The caterpillars of many butterflies and moths can be well preserved by inflation. The specimen is killed in a cyanide bottle, laid on a piece of blotting paper, pressed lightly with a pencil, and the partially protruding intestine ruptured with a needle or a pair of fine forceps. Then lay the pencil crosswise just back of the caterpillar's head and roll it lightly toward the posterior extremity. This will force out the body contents, the process being aided somewhat by removing the intestine with forceps. The rolling must be done very carefully and in many cases repeated once or twice. If undue pressure is used or the pencil allowed to slip, hairs may be lost, the skin bruised and the specimen ruined. In the posterior extremity of the empty skin insert a pointed glass tube or blowpipe, to which is attached a short rubber tube, and fasten the caterpillar skin firmly with collodion, glue or a spring clip. If the blowpipe is inserted so as to distend the posterior opening, withdrawn, heated and inserted again, the skin will usually adhere firmly to the blowpipe. Keep it distended by blowing and at the same time dry by holding it near a lamp chimney or other source of heat. The skin must be dried till rigid, but burning must be carefully avoided. Some caterpillars bear inflation very well, specially certain highly colored ones, but it is exceedingly difficult to obtain nicely inflated green larvae.

More elaborate apparatus can be employed if desired. Some use pneumatic bulbs for forcing the air into the larval skin, but human lungs permit a more delicate adjustment to needs. A lamp chimney can be placed nearly horizontally over a source of heat and serve as a drying oven, or one may be constructed of tin. The latter is by no means necessary and a busy worker will soon depend

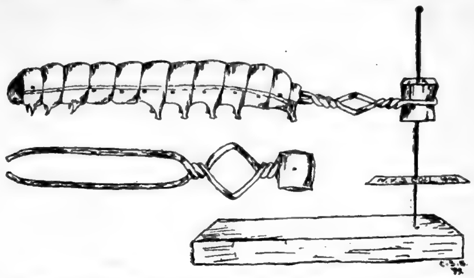

FIG. 22 Inflated larva, showing method of mounting (original).

only on a blowpipe and a convenient lamp. It is well for the beginner to secure a number of rather large common larvae and practise on them. After a caterpillar is well inflated, it must be removed carefully from the blowpipe and mounted. Though it is desirable to have larvae arranged on their food plants, many will prefer to mount them on pins. Twist a light wire round a small cube of cork and bend as represented in the accompanying figure. The two free ends are brought together and gently inserted into the body cavity, their elasticity serving to hold the inflated larva in place, and a pin is thrust through the cube of cork. Some use a straw in place of the wire, pinning through the free end. Inflating and mounting on pins permits the placing of the specimens in cases beside the adults.

Alcoholic material. Many larvae and other soft forms can not be preserved by any of the preceding methods. They should be placed in small vials in 50% alcohol for a day or two, this replaced by 65% and that in turn by 75 to 85% alcohol. If attention is paid to changing the preservative fluid many larvae will keep well. White forms, as for example grubs and some caterpillars, change color less if they are dropped for a moment in boiling water before being placed in the alcohol.

Vials and their care. The vial should be no larger than necessary to hold the specimens and may have various shapes. Ordinary straight vials, preferably with no neck, should be stored in small racks in an upright position or the alcohol will escape more or less by capillary action. As it is desirable to have all the stages of an insect together, various plans have been devised for keeping alcoholic material in cases with the adults. For trays bent necked vials are much used. In the United States national museum the ordinary round vials with bent necks

are slipped between curved wires fixed to a block, which is held firmly in the tray by forcing into the cork the two short brads in its under surface.

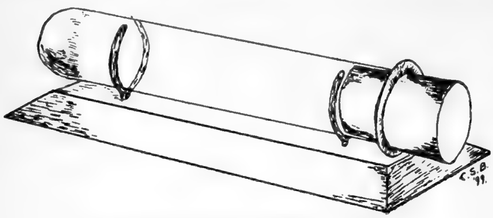

FIG. 23 Vial mounted on block (original).

This arrangement permits the storage of all forms together without much additional weight. In order to avoid distortion caused by the curved surface of an ordinary vial, Professor Comstock of Cornell university uses a square form made with a bent neck, but the extra expense and increased weight will tend to prevent its adoption to a great extent.

Vials containing insects should be kept full of alcohol, as specimens so preserved are much less injured by jarring, and as they are always covered by the fluid, even when the vials are on their side, there is less opportunity for discoloration. Rubber stoppers are regarded as best, though first quality corks give good results. In order to have the vial full, plenty of alcohol is put in and a pin held against the upper side of the stopper as it is inserted, allows the air to escape and also the small amount of superfluous liquid.

FIG. 24 Use of pin in corking vial (original).

Labeling insects. Now that considerable attention is being paid to the distribution and life history of insects, no specimen should be mounted without putting on the pin with it a label bearing at least the locality and date of its capture. This record should be intelligible to all. The name and abbreviation of both town and state should appear, for if only the town is given and the specimen sent to another state in exchange, serious confusion might result. For the same reason it is better to use an abbreviation for the month, rather than a numeral, because 5, 7/99 may mean either May 7/99 or 5 July '99, according to the custom of the reader. This label should be small, in order to economize space, and should always accompany the specimen. It costs little, is neater and

Albany, N. Y.	Albany, N. Y.	Albany, N. Y.	Albany, N. Y.	Albany, N. Y.
June 1899	June 1899	June 1899	June 1899	June 1899
N. Y. S. Coll.	N. Y. S. Coll.	N. Y. S. Coll.	N. Y. S. Coll.	N. Y. S. Coll.

FIG. 25 Locality and date labels used in state etomologist's office.

saves space to have these labels printed, leaving blanks for the day of the month and the year. If these are set solid when printed, no trimming will be necessary as the labels have only to be cut apart. When

writing labels, specially for alcoholic specimens, use india or an engrossing ink, as ordinary inks fade after a few years exposure to light. In the case of insects received from others it is well to include the name of the donor, which may either be on the same label with the locality and date or on a separate slip. When the name of the insect is known, that may be written on a larger label and put on the pin below the locality label. It is sometimes very desirable to attach other information to a specimen, but the capacity of a label is limited, and for this purpose numbers may be used. A numeral is given each insect with something worthy of note and the record entered opposite this number in a book or on a slip. In case it is desirable to make one record applying to a large number of specimens, specially if widely separated, a lot number may be given and a small label bearing it put on the pin of each. This lot number refers in a similar manner to a record book concerning the various lots of insects. For example one lot has been determined by a specialist, while another may have been taken under peculiar conditions.

Insect cases. A collector soon finds himself with a number of specimens and no place to store them. At first they may be put in cigar boxes, or even in pasteboard boxes, but museum pests find them readily in such places and rapid ruin follows unless the most vigilant care is exercised. The destructiveness of pests renders a tight case of some form a necessity. To exclude insects, light, dust and other enemies of a collection, various cases have been designed and are for sale by dealers. The essentials of a good case are that it shall be tight when closed, of a convenient size, durable and not too expensive. It must be well made or in the course of a few years warping and checking render it practically worthless. It will also be found economical to have the case lined with sheet or pressed cork to facilitate pinning specimens. The Schmidt case is very good and convenient in many respects and is extensively used in the United States national museum. It is made of white pine, shellacked or varnished, and has outside dimensions of 33x21.5x6.7 cm ($13x8\frac{1}{2}x2\frac{5}{8}$ in.). The top and bottom are cross grain veneered, the latter lined with cork, the two halves hinged at the back and held together tightly with hooks and eyes.

A good case, extensively used by Dr Lintner in his private collection, has outside dimensions of 29.2x36.7x6.1 cm ($11\frac{1}{2}x14\frac{1}{2}x2\frac{1}{2}$ in.) and inside a clear space of 4.2 cm ($1\frac{3}{4}$ in.). The sides are 1.2 cm ($\frac{7}{16}$ in.) thick, of well-seasoned pine or whitewood, and are lined with tea lead, the lining extending for a short distance over the corked bottom, which is composed

of .8 cm ($\frac{5}{16}$ in.) stuff. The covering glass 27.7x35.5 cm ($10\frac{7}{8}$x$13\frac{7}{8}$ in.) fits into a rabbet .5x.8 cm ($\frac{3}{16}$x$\frac{5}{16}$ in.), and is held down closely on the tea lead with glazier's triangles. The cork lining the bottom is covered with white paper and the whole outside with manila paper. This case can be made by anyone having some skill with carpenter's tools, and if well constructed is very rarely troubled by pests, the lead apparently being obnoxious to them.

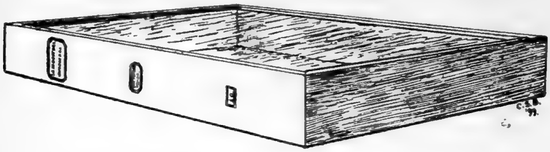

FIG. 26 Insect case much used by Dr Lintner (original).

For the display of butterflies and moths, a larger case, preferably a horizontal tray, is desirable. In adopting a large drawer it is well to select a size uniform with those used in museums and to insist on the trays being interchangeable. One of the best insect cases is the form adopted by the late Dr Riley for the United States national museum. It is 45.5 cm (18 in.) square and has an outside depth of 7.6 cm (3 in.). The sides and back are .9 mm ($\frac{3}{8}$ in.) and the front of 1.6 cm ($\frac{5}{8}$ in.) stuff, while the bottom is composed of three ply cross-grained veneer in order to prevent checking. The back and side pieces are dovetailed and the bottom fitted into a groove. Inside of the outer frame is a secondary box of 3 mm ($\frac{1}{8}$ in.) whitewood, closely fitted and held 6 mm ($\frac{1}{4}$ in.) from back and sides and 9 mm ($\frac{3}{8}$ in.) from the front by blocks. The space between the two boxes is used for insecticides, usually naphthaline, and the 6 mm ($\frac{1}{4}$ in.) tongue of the cover, a frame 1.9 cm ($\frac{3}{4}$ in.) wide and 9 mm ($\frac{3}{8}$ in.) thick holding a single thick glass, fits tightly into the space between the outer and inner box. The first lot was made of California redwood with a cover frame of mahogany, but those made later are of cheaper materials; basswood or whitewood is good. These trays are made to slide on a groove. The outside of the case may be left its natural color, but the inside should be lined with white paper or painted with zinc white. Professor Comstock recommends a paint formed by dissolving one part by weight of glue in five of water, thickening to the consistency of paint with zinc white, and applying while warm.

For the Cornell university collection, Professor Comstock has adopted a case with both top and bottom composed of glass. Its outside dimensions are 40.6x48.2x7.6 cm (16x19x3 in.) and the covers are both dovetailed and mitered. The top and bottom of the case are alike, except

that the former is not quite so deep and is grooved to fit over the tongue of the latter. The bottom is covered with a series of wooden blocks 8 mm ($\frac{1}{3}$ in.) thick. 12 of his unit blocks just fill a box. There are various sizes adapted to different needs, the idea being to put all of one species on a single block, thus avoiding the necessity of repinning specimens in rearranging a case, as the blocks themselves can be moved. Where this system is used, it is found advantageous to have some of the larger blocks covered with cork.

Museum pests. In spite of great care and apparently tight cases, the enemies of an insect collection are liable to work into the boxes. As a deterrent to the entrance of insect pests, many entomologists use naphthaline in some form. Naphthaline cones mounted on pins are most convenient, but are rather costly as they retail by dealers at 75 cents a hundred, specially when naphthaline balls can be obtained for less then 10 cents a hundred. These latter can be mounted by thrusting with the aid of pliers the heated head of a pin into the ball. After it has cooled the ball will be firmly attached to the pin, which may then be stuck into the cork lining of any case.

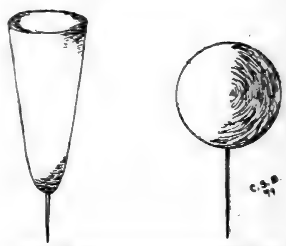

FIG. 27 Naphthaline cone and ball (original).

The presence of museum pests is revealed by the particles of comminuted matter under the injured specimen. Infested cases should be treated with carbon bisulfid, pouring in about a teaspoonful, closing the

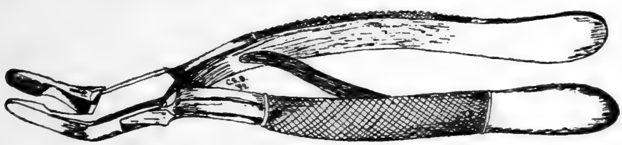

FIG. 28 Pinning forceps (original).

case and allowing it to remain from several hours to a day. This substance evaporates readily and does not injure the specimens. As its gas is inflammable and explosive great care should be exercised to prevent its vapor coming in contact with any source of fire, as a lamp, lighted cigar, etc.

Convenient accessories. When arranging insects in a case, a pair of pinning forceps will be found a great convenience. The large nickel plated dental forceps are the best, but are too expensive for many.

Some cheaper forms are sold, or a pair of ordinary pliers may be used, specially if beveled on one side by grinding. One or more small blocks covered with cork will be found exceedingly convenient for the temporary reception of pinned specimens. A small pocket lens or magnifier is another valuable aid, even in the hands of the amateur, because when collecting in the field or arranging specimens, there is always some form or structure worthy of examination, and if attention is paid to any of the smaller insects a lens is a necessity. Very good pocket magnifiers may be bought at from $.65 to $5. One of the cheaper folding forms with two lenses will be of great service, and is in most cases the best for a beginner. Later a Coddington lens or an achromatic triplet may be purchased and employed for the more detailed examinations, but the cheap lens will also be used to a great extent.

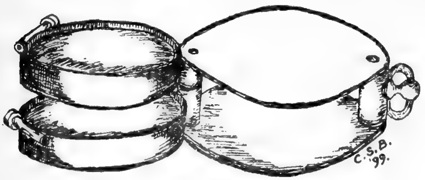

FIG. 29 Pocket lens (original).

Shipping insects. Though many insects are fragile they may be sent through the mails or by express without serious injury, by taking a few necessary precautions. Be sure the package is done up strongly. Lots of insects are received frequently in a dilapidated condition because a poor box was used. Pack insects only in very stout pasteboard boxes, or in light wooden or tin boxes. If pinned specimens are to be sent, they should be put in a small box, the pins firmly set with forceps and the box placed in a larger one, the space between the two being packed firmly with some elastic material. This latter is to lessen the jar and is effective only when not packed so tightly as to destroy its elasticity, and to be of service must be on all sides of the smaller box. Unmounted dead material can be sent safely done up in cotton batting and thin paper. First lay a little batting in the bottom and along the sides of the box, then a sheet of soft paper and put on it, separated slightly from each other, a number of insects, preferably those about the same size, cover with the same paper, lay in more cotton batting and thus fill the the box, taking care to put enough batting on top so that a slight pressure will be necessary to close the box. This will prevent the insects from shaking about and injuring each other.

Living caterpillars or other soft forms should be sent through the mails with a little of their food plant whenever practicable. There is no necessity of providing breathing holes, on the contrary larvae stand the journey better in a tight box which will not permit drying of the food

plant. For this purpose a strong tin box is the best. If more than one species is to be sent, it is well to divide the box and separate them because some caterpillars are so pugnacious that they will destroy others and a few even those of their own kind. Some aquatic larvae will bear transportation very well if packed in damp sphagnum moss, though some of the more delicate forms would have to be put in vials containing 50% alcohol. When sending packages containing liquids through the mails, the government regulations should be observed. Insects are classed as merchandise and sent at the rate of one cent an ounce. The sender's name and address should appear on the upper left hand corner of the package in order to facilitate its identification.

Dealers in entomologic supplies. For the convenience of the novice the addresses of a few dealers are given.

A. Smith & Sons, 269 Pearl st. New York, N. Y.

John Akhurst, 78 Ashland place. Brooklyn, N. Y.

M. Abbott Frazar, 93 Sudbury st. Boston, Mass.

Entomological society of Ontario, 429 Wellington st. London, Ont.

DISTRIBUTION OF INSECTS

The continued introduction of insect pests from other countries and their spread and destructiveness in this land have resulted in considerable attention being given to this important subject. While it is undoubtedly true that many insects can not be excluded from the United States, the rigid inspection at ports of entry by California agents has resulted in the stoppage and destruction of many species before they could threaten any industry by extensive ravages.

Importance. The importance of knowing the actual distribution of injurious insects has hardly occurred to many. Isothermal lines have been indicated over this country and present some interesting curves, but the temperature does not entirely control though it undoubtedly greatly influences the distribution of insects. Degrees of moisture, variations in soil and other features also have their effect. In determining the physical limitations of one species, we gain some idea of those governing others. New York state possesses a most important port of entry, many ships unlading at New York city varied cargoes from all parts of the world. The long and low-lying Hudson river valley offers a natural pathway from this port into the state for such species as find our climate congenial. A number of important insect pests have already established themselves in this valley and are spreading

over the state. As the climatic conditions limiting their existence in destructive numbers are not definitely known, it is proposed to give some attention to this important subject, at least in an incidental way, and ascertain the actual boundaries not only of the occurrence of an insect, but at what point it ceases to be a destructive pest and also any variations in the number of generations produced in different sections of the state. After several years of study of these subjects, general laws may be deduced that will be of considerable value in determining where such imported pests as the elm-leaf beetle, elm-bark louse, leopard moth, San José scale and others will be destructive. This knowledge will not only enable us to state whether an insect will be injurious in certain localities, but it may also give valuable aid in our attempts to prevent the introduction of insect pests and their subsequent spread over the state.

Life zones. A most valuable addition to our knowledge of factors governing the distribution not only of animals but also of plants, has been made by Dr Merriam and his associates in the United States department of agriculture. As a result the boundaries of certain life zones have been indicated with a considerable degree of accuracy. In New York state three life zones occur, the upper austral, the transition and the boreal. The upper austral includes the western end of Long Island, Staten Island, the Hudson river valley to near Mechanicville and an area bordering Lake Ontario and including Lakes Oneida, Cayuga, Seneca and some of the smaller bodies of water. The boreal is represented by a small area in the Catskills, a much larger one in the heart of the Adirondacks, a small one near the foot of Lake Ontario, and another of about equal size in the southwestern corner of the state. The presence of three life zones within our borders affords excellent facilities for studying the effect of climate upon insect life. It is believed that some attention to this line of work will prove not only of great scientific interest, but will also have an important practical bearing. Dr Howard is of the opinion that the imported elm-leaf beetle, the two asparagus beetles and the San José scale will be confined to the austral life zones. So far as known at present, they are thus limited in this state, though the common asparagus beetle has been taken by my assistant, Mr Banks, near Fort Ticonderoga. This means either that the asparagus beetle can exist on the border of the transition life zone or else that the upper austral extends farther up the Hudson river than at first supposed. The following are some of the native insects which Dr Howard places as austral species, that is confined to the lower and upper austral life zones: Cicada killer,

Megastizus speciosus Drury, bag worm, *Thyridopteryx ephemeraeformis* Haw, saddle back caterpillar, *Sibine stimulea* Clem., nine pronged wheel bug, *Prionidus cristatus* Linn., harlequin cabbage bug, *Murgantia histrionica* Hahn, tulip scale, *Lecanium tulipiferae* Cook, and Carolina mantis, *Stagmomantis carolina* Linn. Exact records of the occurrence of these forms are rare, and notes in regard to them and their relative abundance will be welcomed.

Imported insect pests. The formidable list of injurious insects which have invaded the United States from other countries and now cause immense annual losses, illustrate the importance of this subject. Without attempting an exhaustive compilation, the following are some of the more destructive insects. Attacking the apple, pear, cherry and peach; codling moth, *Tmetocera ocellana* Schiff., apple aphis, *Aphis mali* Fabr., apple tree bark louse, *Mytilaspis pomorum* Bouché, San José scale, *Aspidiotus perniciosus* Comst., pear midge, *Diplosis pyrivora* Riley, bark borer, *Xyleborus dispar* Fabr., pear psylla, *Psylla pyricola* Foerst, cherry aphis, *Myzus cerasi* Fabr., and the peach bark borer, *Scolytus rugulosus* Ratz. These species are well known as dangerous enemies of fruit trees.

Gypsy moth, *Porthetria dispar* Linn., elm-leaf beetle, *Galerucella luteola* Müll., and elm-bark louse, *Gossyparia ulmi* Geoff., are three bad enemies of elms. The first named does not occur in this state, though it has committed extensive ravages in eastern Massachusetts. Wheat has suffered most severely from the Hessian fly, *Cecidomyia destructor* Say, the grain aphis, *Nectarophora granaria* Kirby and from the wheat midge, *Diplosis tritici* Kirby, while clover is frequently attacked by the clover leaf weevil, *Phytonomus punctatus* Fabr., or after it has been dried, by the clover hay worm, *Pyralis costalis* Fabr. A few other imported pests may be named; asparagus beetles *Crioceris asparagi* Linn., and *C. 12-punctata* Linn., onion fly, *Phorbia ceparum* Meigen, cow horn fly *Haematobia serrata* Rob.-Desv., carpet beetle, *Anthrenus scrophulariae* Linn., larder beetle, *Dermestes lardarius* Linn., red ant, *Monomorium pharaonis* Linn. and the croton bug, *Phyllodromia germanica* Fabr.

There is hardly a person who can not recognize in the above-named insects, one or more which has caused him considerable loss, while the farmer knows many of them from sad experience. Yet these have all been introduced from abroad and some are still spreading over the country. Of the 73 injurious species regarded by Dr Howard as of first importance, each causing annual losses running into hundreds of thousands of dollars, 37 have been introduced, 30 are known to be native, while the original home of 6 is open to question. An effort is being made

by the state of Massachusetts to exterminate the gypsy moth. If the fight is given up, another pest will make its way over the land and exact a heavy tribute. It would certainly cost Massachusetts people very much less than $200,000 annually, about what is appropriated at present, to maintain a very efficient system of inspection and treatment to prevent the introduction of insect pests. It is impossible to say beforehand just what insects may become acclimated and injurious, but were due attention given this subject, the danger of admitting such pests could be reduced to a minimum.

Manner of spread. Scale insects as is well known to many from bitter experience are readily spread by transportation of nursery stock, but not of fruit. The young are frequently carried by birds for short distances, and it has been demonstrated that winds will do the same. The English sparrow seems to be an active agent in spreading certain scale insects, for the elm-bark louse, *Gossyparia ulmi* Geoff., probably owes its general distribution over Albany and Troy to this bird. Some species like the gypsy moth which has well-developed wings but does not use them to any extent, and the white-marked tussock moth, the female of which is wingless, depend very largely upon the caterpillars crawling or being carried by some agency. The young larvae may be blown some distance by winds, but many are carried by animals, teams and other conveyances. Elm-leaf beetles are frequently seen resting on the clothing of people and there is no reason why they should not be carried by teams. In Troy, N. Y., it seems as if the electric cars were prominent factors in distributing this pest over the city. Many insects are transported in soil or rubbish accompanying their food plant. Such is probably the case with both asparagus beetles, for otherwise their occurrence here and there in the state could hardly be explained. Many winged insects fly long distances, and when this is true of the females, there is little hope of restricting their spread. The presence of well-developed wings is no proof that the insect flies great distances, though some are known to take extended flights. The monarch butterfly, *Anosia plexippus* Linn., is believed unable to stand our northern winters and the race is maintained here only by adults flying from the south. There are a number of records of butterflies being found at sea, in one instance 1000 miles from the mainland. Certain owlet moths, or Noctuidae, and the hawk moths, Sphingidae, have a strong flight and some species have been found far out at sea. Honey and bumble bees fly considerable distances and the same is true of certain beetles. In early spring it is by no means uncommon to see Colorado potato beetles flying over fields of considerable

extent in search of their food plant, yet this insect required about 15 years to make its way from Colorado to New England.

Practical application. In the case of canker worms, the white-marked tussock moth and other species with wingless females, advantage can be taken of their limited means of distribution to exclude them from trees once cleaned. This possibility warrants considerable expense in clearing them from a tree. The introduction of scale or other insects on a farm may be prevented to a great extent by studying their means of distribution and adopting proper methods to attain the desired results. It would be much safer to buy trees that have been fumigated, or even undergo the expense of fumigating purchased stock, rather than admit a pest that can be excluded by reasonable care. There are some insects which fly relatively short distances, for example the elm-leaf beetle; the parent of the apple maggot is said to have this habit, and there are probably others, but we know altogether too little regarding how far each species will fly. Those confined to relatively short aerial flights can be kept in check in one orchard with comparative ease, even though neighboring ones are badly affected, but such is not the case when the females habitually fly long distances before depositing eggs. It is only under exceptional circumstances that the length of flight can be determined for a species, but whenever an opportunity offers it should be seized. Studying the spread of insects is most fascinating field work, something that may be taken up by all and is also of great practical value, because an insect can not be controlled in the best way till its limitations in this respect are known.

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SHADE TREE PESTS

IN

NEW YORK STATE

BY

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State Entomologist

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CONTENTS

The annual depredations of the white marked tussock moth, the severe injuries inflicted by the forest tent caterpillar not only on forest trees and sugar orchards but also on shade trees, the insidious work of wood and bark borers and the extreme destructiveness of the elm leaf beetle, have all combined to emphasize the vital importance of protecting shade trees in the cities and villages of this state.

Injuries to trees. Some idea of the destructive powers of shade tree pests may be gained by examining their past history. Albany and Troy have each lost over a thousand magnificent trees in the last five years through the work of the elm leaf beetle and its associates. The elms were not only defoliated once, but a second crop of leaves was frequently stripped from the trees, thus causing speedy death. About nine years ago thousands of trees were killed in Brooklyn, N. Y., by the maple tree scale insect, and last year it was so abundant as to inflict much damage in many localities. The white marked tussock moth yearly defoliates many valuable trees, in spite of the fact that a few well directed efforts would keep it in check. In most cases no effort is made to control the outbreak of an insect till it has about passed the remedial stage. That is, the insect has nearly completed its growth and therefore can not be poisoned through its food, or else the foliage is so completely devoured that there is very little to poison. Those interested in the welfare of trees, should be posted in regard to their principal insect enemies and be prepared to give their trees adequate protection.

Object of bulletin. The aim of this bulletin is to present in concise form the characteristics of the more destructive species attacking our principal shade trees, both through descriptions and figures, and to indicate methods of controlling them. If the insect does not agree with any of those described in the following pages, examples should be submitted to the state entomologist and the proper method of controlling it learned. In case of a very severe attack, it would probably be wiser to fight on general principles and ascertain more in regard to it later, for a host of caterpillars can cause irreparable damage in a few days if left alone. It is much easier to control insects than to subdue them after they have obtained a good start.

WHITE MARKED TUSSOCK MOTH

Notolophus leucostigma Sm. and Abb.

This species feeds readily on elm and maple leaves, displaying a special preference for those of horse chestnut and linden, and frequently does considerable damage. Last year it was a scourge in some cities of this state.

Characteristics. The caterpillar has a coral red head, a pair of long black plumes just over it, a single one at the opposite extremity of the body, four delicate yellowish or white brush-like tufts on the back, and just behind them, separated only by a segment, two small, retractile, red elevations. Along the back, except for the tubercles and tufts, there is a broad black band bordered by yellowish tubercles. A black line indicates the position of the spiracles or breathing pores, and below this latter line it is yellow, the legs being paler (fig. 1, *a*). This gives the

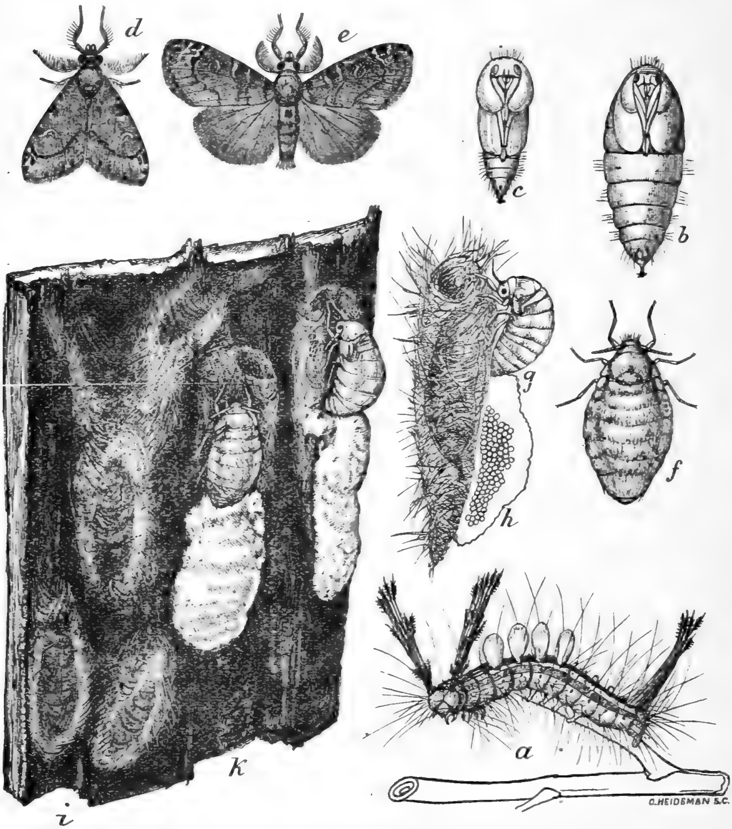


Fig. 1 White marked tussock moth. *a*, larva; *b*, female pupa; *c*, male pupa; *d*, *e*, male moth; *f*, female moth; *g*, same ovipositing; *h*, egg mass; *i*, male cocoons; *k*, female cocoons, with moths laying eggs—all slightly enlarged (after Howard [Division entomology], U. S. Dep't agriculture, year book, 1895).

general appearance of the caterpillar when it is half or two thirds grown, and at a time when its depredations begin to be apparent. The recently hatched larva is a pale yellowish or whitish creature with long, irregular hairs. As it feeds, increases in size and casts its skin from time to time, one after another of the characteristics of the full grown larva are assumed.

When maturity is reached, the larvae spin their thin cocoons in the crevices of the bark (fig. 1, *i*), interweaving their long hairs, and within this shelter transform to yellowish white pupae more or less shaded with dark brown or black (fig. 1, *b*, *c*).

The difference between the sexes is strikingly shown by comparing in figure 1, *d* and *e*, illustrations of the male, with *f*, that of the female. The former is a beautiful moth with large feathery antennae, the legs tufted, and the wings and body delicately marked with several shades of gray and grayish white. On the other hand the female is a nearly uniform gray, with simple antennae and but rudimentary wings.

After remaining from 10 to 15 days in the pupa state, the wingless female emerges and deposits her eggs on the empty cocoon under a conspicuous white mass of frothy matter (fig. 1, *h*, *k*), which soon hardens and forms a very effective protection. The individual egg is nearly spheric, about $\frac{1}{25}$ in. in diameter, white or yellowish white, and with a light brown spot surrounded by a ring of the same color.

Life history. The winter is passed in the egg state, the young, emerging about the latter part of May in this latitude, feed on the under side of the leaves at first and complete their growth in about a month, the transformation to the pupa state occurring the latter part of June and early in July. In Albany there is normally but one annual generation, but in New York city and vicinity there are two broods each season.

Remedies. The simplest and most satisfactory remedy is found in gathering and destroying the egg masses. As the eggs are in a compact mass, which is conspicuous and readily torn from the supporting cocoon, either by hand or by some form of a scraper, the task is quickly and easily performed. On account of the females being wingless, a tree once thoroughly cleaned will not become reinfested very soon if larvae are not abundant near by, and even then a band of loose cotton bound tightly around the trunk will prevent their ascending and a consequent reinfestation. This band is of value only when the tree is clean, and has not the slightest effect on caterpillars already in the trees unless they are shaken down. Only the eggs should be collected and destroyed, otherwise many beneficial parasites would be killed in cocoons not bearing egg masses. The egg masses may be collected any time after their deposition in the summer and prior to their hatching in the spring. The best time is in early spring just before the leaves appear, as this gives an opportunity for parasites to escape before the cocoons are touched and the absence of leaves facilitates the detection of the egg masses. In Rochester, N. Y., prizes were offered in 1894 to the school children gathering the largest number of egg masses with

most excellent results. In cities and villages where this insect is the only important enemy of shade trees, this system or the payment of a bounty on eggs collected would undoubtedly result in the pest being kept in subjection at a comparatively small outlay. It may also be controlled by spraying, which will be discussed under a separate heading.

ELM LEAF BEETLE

Galerucella luteola Müll.

Along the Hudson river valley as far north as Troy, this insect is the worst enemy of the elms, specially the European forms, though under certain conditions it may inflict much injury on the American elms. So far as known, this pest has not made its way to any great distance from the Hudson river in this state, excepting on Long Island.

Characteristics. The elm leaf beetle is about $\frac{1}{4}$ inch long with the head, thorax and margins of the wing covers a reddish yellow. The coal black eyes and median spot of the same color on the head are prominent. Its other black and yellowish or yellowish green markings may be made out by aid of figure 2, plate 1. They are usually constant in the adult, but the colors are quite variable during life and change more or less after death. In some beetles emerging from winter quarters, the conspicuous greenish yellow stripes of the wing covers are nearly black. In the early spring the beetles are found in houses, sheds and other shelters where they pass the winter. On the appearance of the foliage, from about the first to the middle of May, the beetles fly to the trees and, after eating roundish holes (pl. 2, fig. 1) for some time, deposit their yellowish eggs in irregular rows side by side, forming clusters of from 5 to 26 or more (pl. 1, fig. 3), over half the total number of eggs laid being deposited between about the 10th and 20th day after oviposition begins, comparatively few being laid from the 20th to the 30th days.

The young grubs (pl. 1, fig. 4), about $\frac{1}{20}$ inch long and well provided with black tubercles and rather long hairs of the same color, appear early in June and feed only on the under surface of the leaves (pl. 2, fig. 2). They complete their growth in from 15 to 20 days and the mature ones (pl. 1, fig. 5) may be reeognized by the broad yellow stripe dorsally and a narrower stripe of the same color on each side, the yellow stripes being separated by broad dark bands thickly set with tubercles bearing short, dark colored hairs. The full grown larvae or grubs descend the trees and transform to orange yellow pupae (pl. 1, fig. 7) in the crevices of the larger limbs and trunks, and on the ground around the base of the trees, where they sometimes

form layers nearly half an inch deep. In such places they change to beetles in five or more days. Up to 1894 this was supposed to complete the life history of the insect in this latitude, but that year the late Dr Lintner discovered the presence of a second brood and subsequent observations have not only demonstrated this to be the rule but that under exceptional circumstances there may even be a partial third generation. The grubs of the second generation are destructive in August. The development of the first brood is governed to some extent by local conditions, and later in the summer there is considerable diversity even on trees of the same street. The bulk of the larvae may be pupating under some elms, while on others numerous eggs and young may be found. The various stages of this insect are passed so rapidly that close observation and a ready adaptation to conditions are necessary in attempting to control it.

Remedies. Since the beetles fly into the trees each spring, the application of bands of any substance around the trunk will not have the slightest effect in preventing attack. A band is of value only when it keeps an insect not already in the tree from ascending the trunk. Sticky fly paper has been placed around trees attacked by elm leaf beetles and many of the descending grubs were captured, but the number killed is but a drop in the bucket compared with the host that transform in safety above. The grubs may also be killed in large numbers as they lie in masses around the trunk. But even this can be considered as but a palliative measure, for a considerable proportion must escape, and as the beetles are so prolific (one may deposit over 600 eggs), it requires comparatively few to cause serious injury. Another so called remedy is plugging the afflicted trees with sulfur or other compound. The idea being to introduce into the trunk, where it will be taken up by the sap, some substance which will not injure the tree and yet kill the insects, or at least render the foliage distasteful to them. It is a plausible theory but has no foundation in fact. The only thoroughly satisfactory treatment for this insect is found in spraying the foliage with some arsenical compound. The method of doing this will be treated of more fully on following pages.

ELM BARK LOUSE

Gossyparia ulmi Geof.

Elms along the Hudson river are unfortunate in suffering from a bark louse, which, like the elm leaf beetle, is an imported insect and prefers European elms.

Characteristics. The affected trees are easily recognized in midsummer by their blackened appearance, which is caused by the growth of a fungus in the honey dew excreted by the bark louse and covering the foliage, limbs and ground beneath. In sunlight, minute drops of the secretion may be seen falling in showers from the clusters of insects, giving an idea of the drain this species must be upon the vitality of an elm. The limbs which have harbored this bark louse for a few years begin to die, the tree itself shows signs of weakness, and when it is attacked by both the elm leaf beetle and this bark louse, succumbs shortly.

The adult females are rather conspicuous and may be found on the under side of the smaller branches, frequently clustered in masses and appearing not unlike certain lichens (pl. 2, fig. 3). In June each is about $\frac{1}{10}$ inch long, oval in outline, with the extremities slightly pointed, and if crushed causes a reddish stain from the contained ova. The body is surrounded by a mass of white, woolly secretion and the segmentation is also indicated by the same substance. The minute yellow young make their appearance early in July and soon settle for a time on the greener twigs and along the principal veins of the leaves. In the autumn the back of the partly grown bark louse is covered with spiny processes secreting a white waxy matter. At this time most of the insects forsake the leaves and settle for the winter in crevices of the bark. In the early spring activity is resumed and the round of life completed.

Remedies. As this insect is one of the sucking forms, securing its nourishment through slender hair like mouth parts from the under-lying tissues of the bark, its food can not be poisoned and recourse must be had to contact insecticides, as will be explained later.

TENT CATERPILLARS

Clisiocampa disstria Hübn.: *Clisiocampa americana* Fabr.

Complaints are received each spring of injuries to maples and other shade trees by caterpillars. Examples submitted show that the offender is more frequently the forest tent caterpillar, though occasionally its near relative, the apple tree tent caterpillar, may be a partner in the mischief.

Characteristics. The caterpillars of the two species may be readily distinguished. The forest tent caterpillar has a blue head and a row of 10 silvery white spots down the back, as represented in figure 2. The apple tree tent caterpillar has a black head with a bluish white stripe along the back. The former spins its web against the bark of a tree

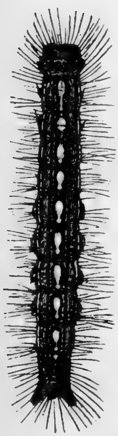


Fig. 2 Forest tent caterpillar (after Riley).

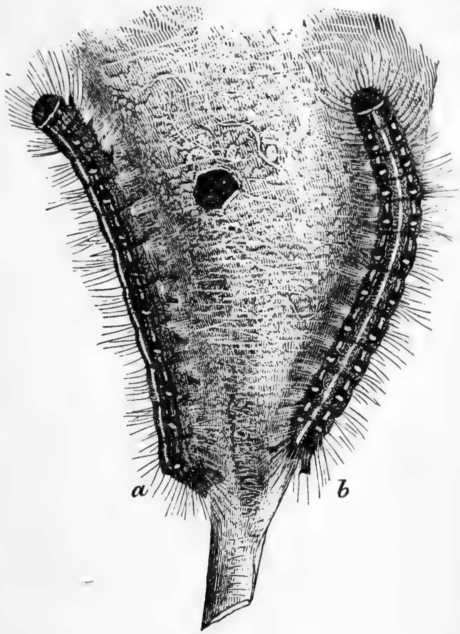


Fig. 3 Apple tree tent caterpillars and nest (after Riley).

and on this account its threads are frequently overlooked, while the conspicuous tents (fig. 3) of the latter are familiar objects in many orchards and in wild cherry trees along the roadside.

Life history. The life histories of these two species are quite similar. The eggs which are deposited in broad belts in June or July around the smaller twigs, those of each species being easily distinguished from the other (see fig. 4, 5), do not usually hatch till spring. The caterpillars appear early and feed most voraciously, the forest tent caterpillar completing its growth in June or the first of July, while the other matures a little earlier. The moths emerge the latter half of June or the first half of July and deposit their eggs from which caterpillars come another spring.

Remedies. The caterpillars of both of these species are very susceptible to arsenical poisons and can be readily controlled by spraying, as will be described later. In case the expense attendant upon this

operation is too great, something may be done by jarring the caterpillars from the trees, first applying a broad sticky band, e. g., tar on thick building paper, tangle foot fly paper, etc., or a band of loose cotton around the trunk so as to prevent the dislodged enemy from ascending. The jarring can be performed best on a bright day when the caterpillars are feeding on the leaves, as they are then much more easily disturbed. Send a boy into the tree with a padded mallet with instructions to begin near the top and jar the depredators from the limbs. Those hanging persistently by long threads may be swept down with a pole. Kill the caterpillars as they assemble below the sticky band in order to guard against their bridging it when present in numbers, and repeat the jarring at intervals of a day or two till the trees are comparatively free from the pests. The caterpillars of the white marked tussock moth can also be treated in this manner. Many forest tent caterpillars can be killed by spraying with kerosene emulsion when they assemble in large masses on the lower limbs and trunks for the purpose of molting. At this time, they may also be brushed down or forced to drop by the judicious use of a torch. Apple tree tent caterpillars, on account of their remaining during damp or cold weather in their webs, can easily be removed and destroyed at these times.

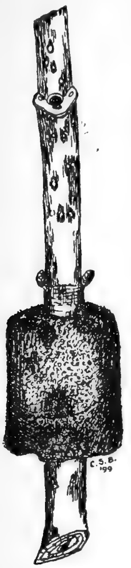


Fig. 4 Egg belt of forest tent caterpillar, showing a few exposed eggs, enlarged

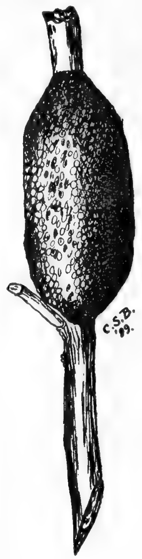


Fig. 5 Egg belt of apple tent caterpillar, enlarged.

FALL WEB WORM

Hyphantria cunea Drury

During the latter part of August in this latitude, conspicuous webs are frequently seen nclosing the tips of branches of many trees, each web containing brown skeletonized leaves. This is the work of the fall web worm and may be easily distinguished from that of the apple tree tent caterpillar not only because they occur later in the season but the tips of the branches are inclosed and the caterpillars feed within the webs, while those of the common apple tree species use the web only as a retreat when not feeding.

Remedies. These gregarious caterpillars are easily destroyed within the web by removing and burning the infested portion of the limb. They can also be controlled by the use of poisons.

BORERS IN TRUNK AND LIMBS

There are several very injurious borers infesting the trunks and branches of elm and maple trees, and since they work under the bark or within the wood, it is extremely difficult to control them.

Indications of attack. The presence of these insidious enemies is usually indicated by one or more dead branches and a more or less sickly appearance of the tree. Borings or "saw dust" may be found around the base of the tree in some instances, and in bad attacks large patches of loose bark may be found. On removing or cutting into the bark, the familiar work of borers is exposed (pl. 3, fig. 3), and the white, usually legless, somewhat flattened grubs may be seen lying in their burrows.

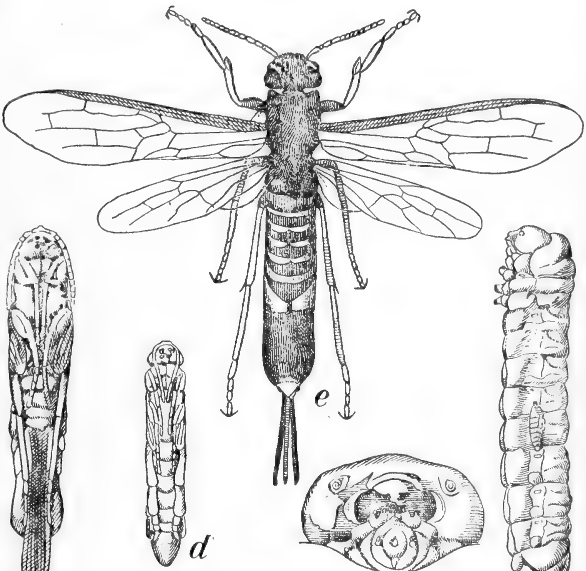


Fig. 6. **Pigeon Tremex; *a*, larva showing the Thalessa larva fastened to its side; *b*, head of larva; *c*, pupa of female; *d*, male pupa; *e*, adult female—all slightly enlarged.**

Elm and maple borers. The parent of the maple tree borer *Plagionotus speciosus* Say, is a handsome black beetle with yellow markings and is represented on plate 3, figure 1. The adult of the more common of the elm tree borers, *Saperda tridentata* Oliv., is a slaty colored beetle with dull reddish markings and is represented on plate 3, figure 2. The thick fleshy grubs of several curculios or weevils are sometimes found in numbers just beneath the bark of elms and occasionally cause considerable injury.

Pigeon Tremex. The larva of another insect known as the pigeon Tremex, *Tremex columba* Linn., or horn tail, runs large burrows through the wood of elms and other trees, specially those which have been weakened by the attack of some other insect. Its various stages are repre-

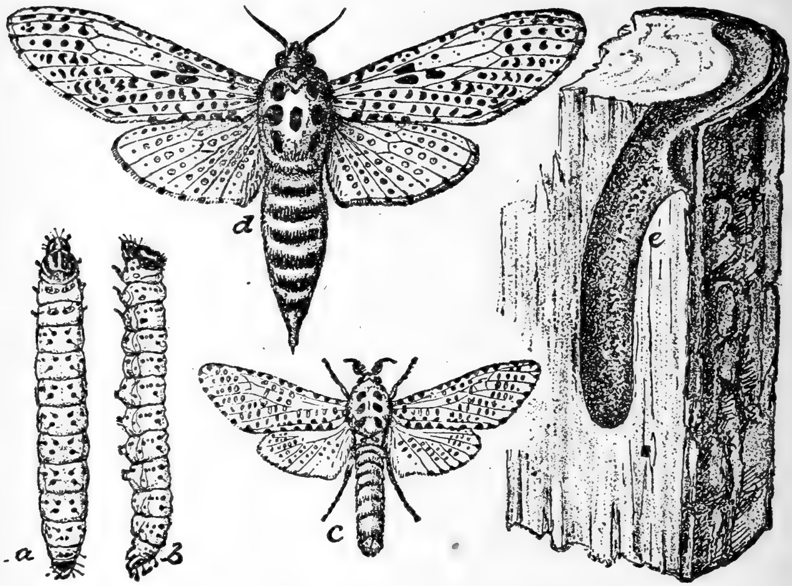


Fig. 7 Leopard moth: *a*, *b*, dorsal and lateral aspects of caterpillar; *c*, *d*, male and female moths; *e*, burrow of caterpillar (after Pike).

sented in figure 6. The female is a magnificent brown insect with yellowish markings and is occasionally found attached to a tree by its inserted ovipositor.

Leopard moth. In the vicinity of New York city there is another borer very injurious to elms and maples. It is the caterpillar of the leopard moth, *Zeuzera pyrina* Fabr., a species which has recently made its way to our shores and is proving a serious pest. This insect and its work may be recognized by the accompanying illustration, the moth being white marked with black.

Remedies. One of the best preventives of borers is to maintain the trees in a flourishing condition. The prompt removal and destruction, in order that no insects may escape to propagate their kind, of infested trees or limbs will do much to keep these pests under control, and in the case of those suffering from a severe attack, is almost the only remedy. The handsome beetles of the maple tree borer are abroad during June, July and August, their eggs being deposited the latter two months. The adults of the elm borer may be found during May and June, the eggs being laid the latter month. If the attack has not proceeded too far and the trees are of sufficient value, a considerable degree of protection will probably be obtained by coating the trunk of the maple and the trunk and larger limbs of the elm with a solution of soft soap and carbolic acid during the period these beetles deposit eggs, thus preventing further infestation. This solution may be applied either as a spray or with brushes and should be renewed as often as washed off by rains during the period of oviposition. In the case of more valuable trees, specially those infested with the fleshy grubs of curculios or weevils, it may pay in some instances to shave away the bark over the infested portions, till living tissues are reached, and kill the borers by the application of kerosene emulsion, and then protect the treated areas from drying by applying a coating of some thick, adhesive substance, e. g. a mixture of cow dung and lime, grafting wax or other substance. Experiments conducted in France have shown that much more of the bark may be removed, even strips two inches wide, and the trees not only recovered but the borers were killed by the vigorous growth made in the effort to heal the wounds. In case of very severe attacks, this would certainly be worth trying. The best results would probably be obtained if the operation was performed in the spring. The pigeon Tremex works so deeply in the wood, that little can be done to arrest its attack, but fortunately it infests only sickly trees, as a rule, and therefore simply aids in the final destruction of a tree.

Serious injury by the leopard moth can only be prevented, in regions where it occurs, by constant watchfulness. Indications of its presence should lead to immediate examination and the digging out of the borer or the destruction of the infested limb. Some of the more valuable trees in the parks of New York city are protected from this pest by killing the caterpillars in their burrows with a wire and when this is not possible, resort is had to carbon bisulfid, which is injected into the burrow by the aid of a long nosed oil can and the opening is then closed with putty.

COTTONY MAPLE TREE SCALE INSECT

Pulvinaria innumerabilis Rathv.

Maples and occasionally elms suffer severely at times from the attacks of this scale insect. A few full grown individuals are represented in the accompanying figure. The insect may be recognized by its brownish scale at one end of a large white cottony mass. In bad attacks, the insects may form festoons along the under side of the smaller limbs.

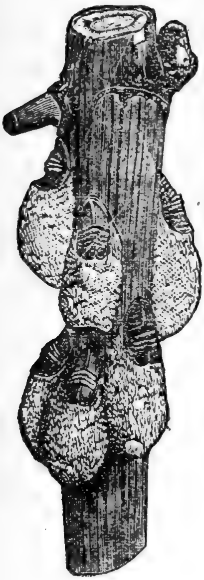


Fig. 8 Cottony maple tree scale insect.

Remedies. Like the elm bark louse this species obtains its food by suction from the underlying tissues and therefore can not be poisoned. The cottony mass covering the body of the female protects her from contact insecticides, consequently little can be done till the unprotected young appear in July, when spraying with kerosene emulsion or whale oil soap solution will be found most effective.

VALUE OF OUR NATIVE BIRDS

The valuable services rendered by our native birds should be more generally recognized. It is a matter of record that after the introduction of the English sparrow, most of our native birds were driven from the cities and that the tussock moth caterpillars, previously hardly noticed as pests, became destructive. It is very true that prior to the introduction of the English sparrow, a measuring worm had been a pest in various cities, but this is an additional proof of the effect birds may have upon insect life. In the same way there are a number of birds known to prey on the tent caterpillars and were these friends of man accorded the protection and encouragement they deserve, instead of being hunted and driven away, it is very probable that the ravages of these pests would be much less severe than at present. Robins, orioles, chipping sparrows, cat birds, cuckoos, the red eyed, white eyed and warbling vireos, cedar birds and nuthatches have been observed feeding on forest tent caterpillars by Miss Soule. "The nuthatches would stand by a patch of larvae lying close together below a tar band on a tree and eat so voraciously and with such an entire abandonment of self-consciousness that I could go close and put my hand on them before they would fly. This experience was repeated several times."[a] The

[a] Weed, C. M. New Hampshire agricultural experiment station. Bulletin 64. April 1899 (cites and quotes Miss Soule)

value of birds in keeping other pests under control is also strikingly shown in the experiment conducted by Mr E. H. Forbush, ornithologist of the Massachusetts board of agriculture. In a typical orchard at Medford, Mass., a little trouble was taken to attract the native birds, the nests of the English or house sparrow being destroyed. The results were greatly in favor of protecting our indigenous forms. In the neighboring orchards it was evident that canker worms and tent caterpillars were very numerous, but in the orchard in question, the trees were seriously injured in only one or two instances, though no attempt was made to control the insects by spraying or other artificial means.

Our native birds are undoubtedly of great value and will richly repay any slight effort that may be made for the purpose of attracting them to a locality. Winter birds may be induced to remain in a neighborhood by hanging in the trees pieces of meat or partially picked bones, and will spend much time in searching out and devouring numerous insects and their eggs, relying on the meat only when conditions are unfavorable for obtaining insect foot. Migratory birds may be induced to remain in larger numbers in a locality by providing them with suitable nesting places and materials, and by protecting them from cats and cruel boys. Thickets in the vicinity will afford shelter for certain species and if a few mulberry trees are set out, their fruit will serve to protect cherries, as the birds are said to eat the mulberries by preference. Most of these suggestions are taken from a very practical paper by Mr Forbush.

SPRAYING TREES

Though it is rather costly to spray trees in a thorough manner, in the case of the elm leaf beetle at least, it is much more satisfactory than any other method of fighting the pest and possesses the additional advantage of also controlling other leaf feeding species.

Rules for spraying. Apply the poisonous mixture at the time the insects begin to feed and on the part of the tree eaten. To control the elm leaf beetle it is best to spray once after the leaves have partly unfolded in order to kill the beetles before they can deposit many eggs, and a second time early in June for the purpose of destroying the grubs hatching from eggs laid by stray beetles. The second spraying must be on the under surface of the leaves because the grubs eat only the more tender under portions. They grow so rapidly and their development is affected to so great an extent by local conditions that the proper time for treatment must be determined largely by observation. If the eggs of the white marked tussock moth have not been removed, as advised on a preceding page, the caterpillars can be destroyed by spraying the latter

part of May or early in June, and, as in the case of the elm leaf beetle, it is advisable to throw the poison on the under surface of the leaves, since the very young caterpillars rarely break the upper epidermis. The same treatment is also very effective in the case of tent caterpillars, and in each case will be found valuable in proportion to its thoroughness. The aim of the operator should be to cover every leaf evenly with a mist like coating of the poisonous mixture. Spray till the leaves begin to drip but no more.

Proper apparatus. In order to do this work successfully one must possess a force pump capable of throwing a stream some distance, a number of feet of hose and a nozzle which will discharge a rather fine spray. There must also be something to hold the poisonous mixture, while a ladder facilitates the work greatly.

One of the best arrangements for hand work is most probably found in the spraying outfit mounted on wheels, so that it can be readily moved from place to place (plate 4). In most cases this takes the form of a box or barrel to which a force pump is firmly attached, and either provided with wheels or else designed to be placed in a wagon. In spraying tall trees 25 to 50 or more feet of $\frac{1}{4}$ or $\frac{1}{2}$ inch hose should be provided, while the addition of a brass or iron and brass extension 10 to 25 feet long adds materially to the value of the apparatus. It is also necessary to have a good nozzle which will not clog, but will produce a fine spray and which can be quickly adjusted to throw a coarse spray some distance if necessary. Such an outfit is of great service to any individual having considerable spraying to be done and undoubtedly it could be used to advantage by those desiring to make a business of spraying in a small way, as for example the treating of trees here and there for those in cities desiring their trees sprayed and not willing to purchase the necessary apparatus.

In the extended work against this insect conducted by cities and villages, it is desirable to have apparatus that will admit of more rapid work. This has led to the refitting of retired fire engines and the designing of more or less cumbersome outfits for this purpose. In all cases these makeshifts have been successful, though they are not so satisfactory in operation as those specially fitted for the purpose. Probably the best apparatus yet designed for spraying trees is that constructed under the direction of Dr E. B. Southwick, entomologist of the department of public parks of the city of New York, which is the form used in Albany. The whole outfit is represented in plate 5. It consists of a "Daimler" gasoline motor operating a Gould force pump—the motor and pump weighing but 300 pounds can be placed in the

bottom of a spring wagon along with the 100-gallon tank containing the poisonous mixture. This motor has the advantage of being almost noiseless in operation and is scarcely noticed by passing horses. It is very inexpensive to operate, as a gallon of gasoline is sufficient for a day and it requires little attention. The smallest size Gould 3-piston pump is the one used with the motor, though Dr Southwick now recommends a larger one in order to utilize the power more fully. This apparatus, with the tank, 400 ft. of $\frac{3}{8}$ in. rubber hose and other necessary fittings, can be bought for $475. Other engines and pumps could undoubtedly be used and would give good results. This power can easily supply four lines of hose, though in Albany not more than two can be used to advantage in most places.

Mr P. C. Lewis, of Catskill, N. Y., who was in charge of the spraying in Albany in 1898, had several interesting devices for saving time and increasing the efficiency of the work. He designed a modified stepladder, about 16 feet high with platforms for two men and on two of its legs there are small wheels which permit ready removal from place to place. It is so constructed that it can be folded up and drawn behind the wagon when some distance is to be traversed. He also had in constant use a metal extension 25 feet long. The lower portion is composed of larger tubing, thus making it stiffer and at the same time rendering it easier to handle because the greater part of the weight is near the operator. This extremely long extension is suspended by a rope from the top of the modified stepladder in such a manner that the man has only to guide the stream. This arrangement does away with all climbing, as it was found impracticable to attempt to reach the tops of the taller trees. In many instances the huge steps could be placed in the middle of the street and the trees on both sides sprayed either from the steps or from the ground.

Arsenical compounds. These are effective against insects which devour portions of a plant and of value only when placed where they will be eaten. The following formulae are recommended:

Paris green	1 pound
Quicklime	1 pound
Water	100–300 gallons

London purple	1 pound
Quicklime	2–3 pounds
Water	100–300 gallons

The more common proportion is at the rate of 1 pound of the poison to 150 gallons of water, and less should be used on the more tender foliage like that of the peach or there may be serious injury. For the

elm leaf beetle, use 1 pound of the poison to 100 gallons of water. The addition of lime is not necessary, specially with paris green, but is a wise precaution as it neutralizes any free arsenic acid and thus prevents burning of the foliage.

Another substance which has received high praise and may come into general use after its good qualities become better known, is the arsenate of lead. The value of this compound as an insecticide has been brought out by numerous experiments, made in the extensive work against the gypsy moth. One advantage is that it can be applied in very large quantities without injuring the foliage. When properly prepared, it remains for some time suspended in the water, imparting a milky color, and also adheres to the leaves much longer than either paris green or london purple, and it promises to be of special value against the elm leaf beetle on this account. Its whiteness is another advantage, because of which, it is readily detected upon green foliage.

In order to obtain the best results, the poison should be prepared just before using, by dissolving 11 ounces of acetate of lead (sugar of lead) in 4 quarts of water in a wooden pail, and 4 ounces of arsenate of soda (50%) in 2 quarts of water in another wooden pail. As the acetate or sugar of lead dissolves rather slowly in cold water, the process can be hastened by using warm water. The resulting solutions should then be poured into the spraying tank containing enough water to give the desired proportions. In most cases this will mean turning them into 100 or 150 gallons of water, or but 80 gallons of water when spraying for the elm leaf beetles, though some recommend a larger proportion of the poison, and the same amounts to 100 gallons will kill the grubs.

Contact insecticides. These are substances which kill insects by contact and affect only those individuals touched. They are used against the elm bark louse, the woolly scale of the maple and other sucking insects.

Kerosene emulsion is one of the principal contact insecticides and is prepared by dissolving $\frac{1}{2}$ pound of hard soap in 1 gallon of boiling water and while it is still hot add 2 gallons of kerosene and emulsify by passing it rapidly through a force pump and back into the vessel till it assumes a creamy consistency and oil does not rise to the surface. Dilute with 9 to 15 parts of water and spray the young lice as they appear in the summer. In limestone regions where hard water is the rule, better results will probably be obtained by using the sour milk emulsion, which is composed of 2 gallons of kerosene and 1 gallon of sour milk emulsified by churning or passing through a pump. A mechanical mixture of the two may be used, if desired, with machines

now on the market for that purpose. Or a solution of 1 pound of whale oil soap to 4 gallons of water will be found effective. In the use of any of these compounds, thoroughness is of first importance. They may be sprayed on the insects, applied with brushes or in any other way that is convenient, provided the tree is not subjected to such drenching that the insecticide used will collect around the trunk and cause serious injury.

EXPLANATION OF PLATES

Plate 1

Fig. 1 Elm leaves showing eggs and work of young larvae.
Fig. 2 Elm leaf beetle (x2).
Fig. 3 Vertical and lateral view of eggs, very much enlarged.
Fig. 4 Young larva, very much enlarged.
Fig. 5 Full grown larva (x5).

Plate 2

Fig. 1 Leaf showing holes eaten by elm leaf beetle.
Fig. 2 Leaf skeletonized by elm leaf beetle grubs.
Fig. 3 Females of elm bark louse, slightly enlarged.

Plate 3

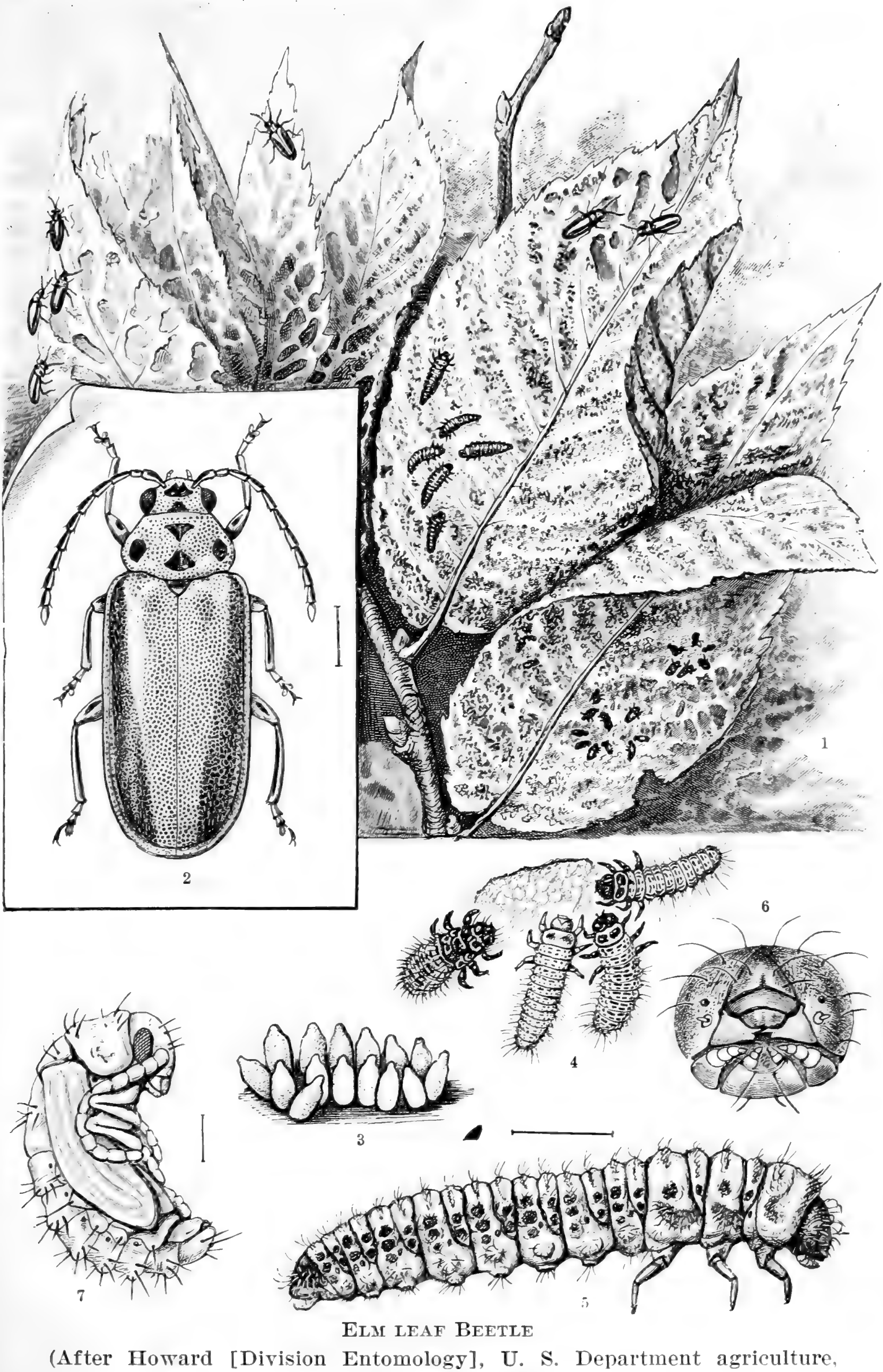
Fig. 1 Maple tree borer, *Plagionotus speciosus.*
Fig. 2 Elm borer, *Saperda tridentata.*
Fig. 3 Work of elm borers, *Saperda* and *Neoclytus.*

Plate 4

Hand spraying outfit in operation.

Plate 5

Power spraying outfit in operation.



ELM LEAF BEETLE
(After Howard [Division Entomology], U. S. Department agriculture, Year book, 1895)

Fig. 3 Females of elm bark louse (slightly enlarged)

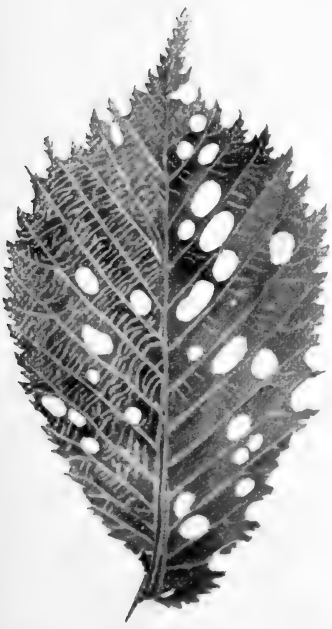


Fig. 1 Leaf showing holes eaten by elm leaf beetle

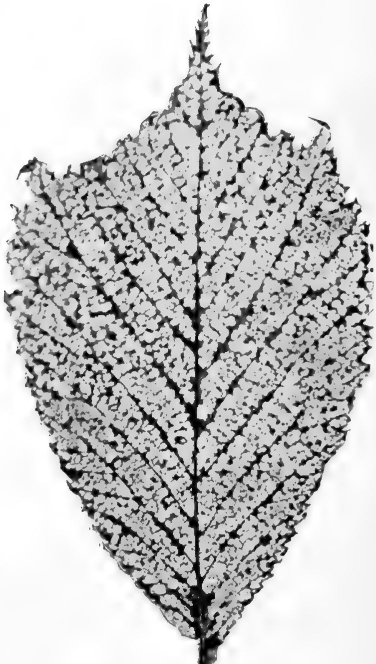


Fig. 2 Work of elm leaf beetle larvae

Fig. 1 Maple tree borer

Fig. 2 Elm tree borer

Fig. 3 Work of borers

Hand spraying outfit in operation

Power spraying outfit in operation

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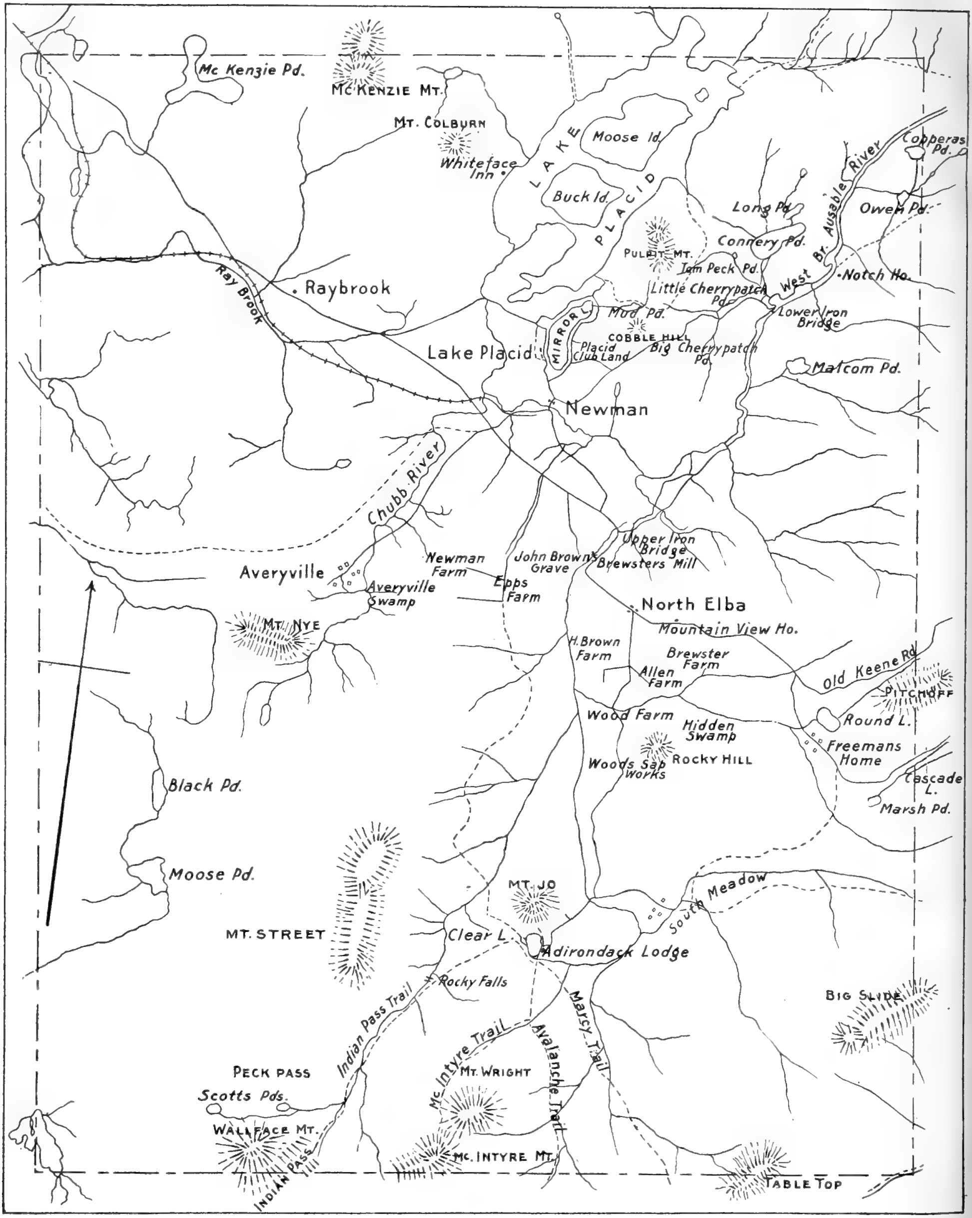

TOWN OF NORTH ELBA, ESSEX CO. N.Y.

Scale of Miles

1 ½ 0 1 2 3 4 MLS.

University of the State of New York

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PLANTS OF NORTH ELBA

Essex county, N. Y.

BY

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State Botanist

ALBANY

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CONTENTS

PLANTS OF NORTH ELBA

The following list of the plants of the town of North Elba has been prepared in response to inquiries for a catalogue of the plants of the Adirondacks. It is designed to show approximately what plants have been found growing in a limited but definite typical area of that region and to serve as an aid to botanists who may desire to study the flora of the town and as a guide to stations where specially rare or interesting species may be found. It may also be made the beginning of a list which shall in time be extended till it shall include the names of the plants of the whole region. This region has, within a few years, come into great prominence and is now attracting much attention by reason of its economic and sanitary importance. Its mineral resources were at one time thought to be great, but these sink into insignificance when compared to the value now placed upon its forests. The state has awakened to an appreciation of the value of these forests and has taken measures looking toward their preservation and utilization. It would make them not only a permanent possession, but contributors to health, wealth and knowledge.

The establishment of the Adirondack park and the institution of a college of forestry are evidences of this. But other plants as well as the trees of the forests can teach us lessons of interest and value if we study them rightly. It is our desire that the following plant list with its notes may be of some aid to those who wish so to study them that they may have a better knowledge of the lessons they teach and of their value as parts of the wooded mountainous region where they grow.

The town of North Elba is in the western part of Essex county north of the center. It is separated from the north line of the county by the narrow northwestern corner town, St Armand. It is situated in one of the most picturesque regions of the Adirondacks and has high mountains on three of its sides. It is about 13.5 miles long and nearly 11 miles wide, containing in round numbers 148 square miles or about 94,700 acres. Its surface is exceedingly diversified by hills, mountains, valleys, plains, fields, forests, lakes and streams. The soil of much of the town is a loam composed largely of sand and gravel which is easily tillable. On the mountains and their steep slopes it is thin and chiefly humus. The ground in the forest is nearly everywhere covered with a carpet of

mosses of various species. Mosses also cover rocks and hang over the wet surfaces of dripping cliffs. Sphagnous or peat mosses abound in bogs, marshes and wet places. They are also often found growing on rocks, wet cliffs and the open summits of high mountains where clouds and rains are so frequent that the necessary conditions are afforded for the growth of these semiaquatic plants.

Mt McIntyre, in the southern part of the town, is the highest mountain. Its altitude is 5112 ft. Mt Marcy, with an altitude of 5344 ft, is the only one of the Adirondack peaks that surpasses it. Mt Wright is next to Mt McIntyre on the northeast and forms a sort of shoulder to it. Mt Wallface on the west is separated from it by the deep and narrow gorge known as Indian pass. Mt Street is north of Mt Wallface and separated from it by Peck pass. Mt Jo is of moderate altitude and is just north of Clear lake. The south end of Pitchoff mountain enters the town on the east between the old road to Keene and the one now used. Pulpit mountain rises abruptly from the east shore of Lake Placid, its perpendicular base at Pulpit rock emerging from the water of the lake. Cobble hill or Altar mountain is southeast of Mud pond. Mt Whiteface lies just beyond the northern boundary of the town. Its rich and varied flora has therefore been excluded.

Lake Placid is the largest of the numerous bodies of water in the town, but its extent is less imposing because of the two large islands, Moose island and Buck island, that occupy its central part and obstruct the view over its surface. It lies in the northern part of the town. Mirror lake is separated from it by the narrow strip of land south of which the village stands. McKenzie pond is near the northwest corner of the town, Connery pond, Long pond and Tom Peck pond are in the northern part east of Lake Placid, Owen pond and Copperas pond are in the northeast corner, Little Cherrypatch and Big Cherrypatch ponds are in the Ausable valley near the lower iron bridge, Round lake and Marsh pond are near Freemans Home in the eastern part of the town and Clear lake is in the southern part at the terminus of the road leading to Adirondack lodge. The head of Cascade lake just enters the town on the east. Scotts ponds are a short distance northwest of Mt Wallface.

Ray brook and its tributaries afford drainage for the northwestern part of the town, the west branch of the Ausable river and its tributaries for nearly all the rest. Chubb river drains Averyville swamp and the contiguous territory. It flows in a northerly direction and uniting with the outlet of Lake Placid near Newman, their combined waters form the chief western tributary of the west branch of the Ausable river. The general direction of this stream through the town is northeasterly. The Ausable valley may be considered for our present purpose to extend

along the river from the confluence of its two principal branches near Wood farm to the point where it leaves the town a short distance north of the Notch house.

A few places are worthy of notice because they are specially interesting to the botanist. They are rich in the variety of their species, or they possess some unusual character or conditions whose influence upon the plants inhabiting them is worthy of careful study or they may be stations for one or more species of rare occurrence.

Averyville is a hamlet about three miles south of Lake Placid. Near it on the east is Averyville swamp. This is the most extensive piece of swamp and marsh land in the town. It is the home of several rare plants which are not known to occur elsewhere in the town. Among these are *Nymphaea hybrida* Pk. *Hippuris vulgaris* L. and *Razoumofskya pusilla* (Pk.) Kuntze. It also affords a fine object lesson for showing the mode of transformation of a shallow lake to a wooded swamp through the intermediate stages of peat bog, cranberry marsh and beaver meadow.

The wooded swamp lying between Wood farm and Freemans Home is interesting because it contains the only known Adirondack station for *Carex altocaulis* (Dew.) Britton. On its borders the white spruce, *Picea Canadensis* (Mill.) B. S. P., occurs as a forest tree. In it also is Hidden swamp, surrounded by woods and difficult to find, once a fruitful field for cranberries, but now too firm and too full of bushes to afford them a congenial home.

The old abandoned road between North Elba and Keene skirts the western base of Pitchoff mountain. Along this road near the east line of the town some interesting plants were found, and on the rocky precipices of the western base of the mountain is the only New York station known to me for the rare but noble arctic lichen, *Nephroma arcticum* (L.) Fr.

About the head of Cascade lake is a station for two or three species not seen in any other part of the town and Marsh pond east of Freemans Home is another interesting botanical locality. In a very dry season its water nearly all disappears and its muddy bottom is then occupied by numerous species of water or mud-loving plants. One of these, *Myriophyllum tenellum* Bigel. is not often found in the Adirondacks.

The region about Scotts ponds, which is northwest of Mt Wallface, is accessible through Peck pass. It contains some small open marshes which may furnish some interesting species. It has not been satisfactorily explored, but it has yielded some specimens of rare mosses. One of these, *Sphagnum Pylaesii* Brid., which usually is found in our state on wet rocks on the open summits of high mountains, was here found growing on soft mud. Another, *Splachnum rubrum* L., has not been found elsewhere in our state.

The top of Mt Wallface is the only known New York station for the spiked wood rush, *Juncoides spicatum* (L.) Kuntze. It is rarely visited by botanists, but it deserves some attention.

Indian pass is one of the most interesting places in the town, not only to the botanist but also to the tourist and the lover of the wildest and grandest scenery. Probably no locality of equal area in the town is inhabited by a greater number of species of mosses and liverworts than this. They cover the vast masses of broken rocks that are here piled together in the utmost confusion, they partly conceal the crevices between them and spring up beneath them in places not occupied too long by the slowly melting accumulations of winter's snow and ice. It is also an excellent place in which to observe the influence of low temperature and limited sunlight in retarding the development of plants not accustomed to such conditions.

The red raspberry, *Rubus strigosus* Mx., the dwarf cornel, *Cornus Canadensis* L. and Labrador tea, *Ledum Groenlandicum* Oeder, which, in other parts of the town, are in blossom in June, were here found in blossom the middle of August. The average altitude of the bottom of the pass is about 2900 ft, but the prevailing low temperature, due in part to the short daily duration of the direct rays of the sun and in part to the presence of deposits of snow and ice under the huge piles of rocks, affords a suitable condition for the maintenance of certain species usually found at a much higher elevation. The bog bilberry, *Vaccinium uliginosum* L., and the fir club moss, *Lycopodium Selago* L., are examples of this kind. The summit of Mt McIntyre is the best locality for high mountain or subalpine species. It and its near neighbor, Mt Wallface, permit us to add to the list several species that occur only in these elevated places. A good trail from Adirondack lodge to the top of Mt McIntyre makes this station easily accessible. By taking an early start the journey can be accomplished in one day, allowing two or three hours for botanizing on the top of the mountain.

There are several interesting localities only a short distance beyond the limits of the town. Had the plants of these places been included the number of species in the list would have been considerably increased. The enthusiastic botanist will not be kept from visiting such places as Mt Whiteface, Eagles eyrie, Wilmington notch, Cascadeville and Avalanche pass because a town line intervenes.

In making this list of the plants of North Elba it has been our purpose to follow the nomenclature of our standard manuals so far as possible, even though they may not in all cases be quite up to date. It is expected that it will be used in connection with these manuals. In the preparation of the list of flowering or seed bearing plants and the ferns and fern allies,

the family grouping and the consecutive arrangement of the last edition of Gray's *Manual* have been adopted, but the names of the species are those of Britton and Brown's *Illustrated flora*. When the name of a species is not the same in both works the name used in the *Manual* is given as a synonym. This will facilitate the use of the list by those who still follow the *Manual*. In this part of the list a synoptical table has been given in those genera which are represented by five or more species. The names and arrangement of the mosses are as far as possible those of the *Manual of North American mosses* by Lesquereux and James. In like manner Underwood's exposition of the liverworts in the last edition of Gray's *Manual* has been followed. The names and arrangement of the lichens are those of Tuckerman's *North American lichens* and Saccardo's *Sylloge fungorum* has chiefly been followed in the list of fungi. The fresh water algae have not been sufficiently collected or studied to warrant their introduction.

It is very evident that this list is far from being complete. A large area of mountainous forest lying between Lake Placid and McKenzie pond has not been explored. The same is true of considerable tracts in the eastern and southeastern parts of the town. Another unexplored region surrounds and includes Mt Street, and a large tract in the western and southwestern part has probably never been visited by any botanist for botanical investigation. It is not unreasonable to suppose that these regions will furnish some additions to the list of flowering plants, ferns and mosses, but it is very evident that many additions may yet be made to the list of fungi, not only from these places, but also by a more extended and careful search in places that have already been visited. Unlisted species may specially be expected among the Hypodermeae, Pyrenomyceteae, Discomyceteae, Hyphomyceteae, Sphaeropsideae and Myxomyceteae.

Many plants not included in the list are known to occur in places just beyond but close to the town limits. It is very probable that some of these will spread from their present stations into the town and become a part of its flora. I shall be glad to learn of any additions to the North Elba flora that botanists may make and of the localities where such additions may be found.

I desire to acknowledge most gratefully the aid I have received from specialists in the preparation of this list of plants. Mrs E. G. Britton, a most excellent and enthusiastic bryologist, has very kindly communicated to me the results of her extensive observation and study of the mosses and liverworts of the region, and has most generously permitted me to make free use of her descriptive and critical notes on the species. She has added many species to the list of the Bryophyta

and much of its interest and value is due to her. Mr A. W. Evans has kindly aided me in the identification of rare and difficult species of liverworts and given me the advantage of his excellent and critical knowledge of these curious bryophytes. Mr W. W. Calkins has done me the same favor in the identification of numerous species of lichens. Prof. G. F. Atkinson has kindly communicated to me the names of many species of lichens and fungi collected by him in the vicinity of Lake Placid.

SEED-BEARING PLANTS

SPERMATOPHYTA

RANUNCULACEAE

Clematis Virginiana *L.*

VIRGIN'S BOWER. VIRGINIA VIRGIN'S BOWER

Valley of the Ausable river and at Newman. August. A vine as beautiful in fruit as in flower.

Anemone quinquefolia *L.*

A. nemorosa var. *quinquefolia* Gray

WIND FLOWER

Moist shady places. Rare. Along the road to John Brown farm. May.

Thalictrum polygamum *Muhl.*

TALL MEADOW RUE

Margin of lakes, along streams, in swamps and wet places. Very common. July and August.

Thalictrum purpurascens *L.*

PURPLISH MEADOW RUE

Dry ground. Rare. Averyville. July.

RANUNCULUS

Stems erect, cauline leaves deeply cleft or lobed	1
Stems not erect, leaves entire	reptans
1 Flowers 6 lines broad or more	acris
1 Flowers less than 6 lines broad	2
2 Fruit head oblong	Pennsylvanicus
2 Fruit head globose	3
3 Basal leaves trilobed	recurvatus
3 Basal leaves generally entire, crenate	abortivus

Ranunculus reptans *L.*

R. Flammula var. *reptans* E. Meyer

CREEPING SPEARWORT

Gravelly or sandy shores. Shore of Lake Placid. This plant was observed near the present boat landing back of the Stevens house many years ago. Recent improvements may have destroyed it there but it probably exists on other parts of the shore or on other shores in the town.

Ranunculus acris *L.*

BUTTERCUPS. MEADOW BUTTERCUP. TALL CROWFOOT

Meadows, pastures and roadsides. An introduced but very common plant. June to September.

Ranunculus Pennsylvanicus *L. f.*

BRISTLY BUTTERCUP. BRISTLY CROWFOOT

Along the stream through Wood farm and probably in the Ausable valley. Scarce. July and August.

Ranunculus recurvatus *Poir.*

HOOKED CROWFOOT

Woods. Common. June. Plentiful along the Adirondack lodge road southeast of Wood farm.

Ranunculus abortivus *L.*

SMALL FLOWERED CROWFOOT. KIDNEY LEAVED CROWFOOT

Meadows and pastures. Sometimes a weed in gardens. Not common. June. This species is easily recognized by its basal leaves which are round or reniform, crenate and often cordate, and are quite unlike the cauline leaves. Rarely the basal leaves or some of them are trilobed.

Batrachium trichophyllum (*Chaix*) *Bossch.*

Ranunculus aquatilis var. *trichophyllus* Gray

WHITE WATER CROWFOOT.

In streams. Ray brook near Raybrook station. This is the only place where it was seen.

Caltha palustris *L.*

MARSH MARIGOLD

Swamps and wet or springy places. Common. May. Abundant along Ray brook.

Coptis trifolia *Salisb.*

GOLDTHREAD. THREE LEAVED GOLDTHREAD

Woods, swamps, mossy places and mountain tops. Common. June. The slender golden yellow thread-like rootstocks, which suggest the common name of this plant, have a bitter taste and have been used as a domestic remedy for sore mouth. The whole plant is said to possess a bitter principle and to have tonic properties.

Aquilegia Canadensis *L.*

WILD COLUMBINE

Rocky places. Rare. West side of Mt Pitchoff. June. It is more plentiful at Cascade lake near the east line of the town. It is a beautiful plant both in flower and foliage and it is sometimes cultivated as an ornamental plant of the garden.

Aquilegia vulgaris *L.*

EUROPEAN COLUMBINE. GARDEN COLUMBINE

This introduced ornamental plant sometimes escapes from gardens and door yards and grows spontaneously along roadsides. In North Elba it occasionally lingers about the sites of dwellings that have been abandoned burned or demolished.

Cimicifuga racemosa *Nutt.*

BLACK SNAKEROOT. BLACK COHOSH

A single cluster of this plant was found growing by the roadside between South Meadow and Adirondack lodge road. It is probably a recent introduction and may not be permanent.

Actaea rubra (*Ait.*) *Willd.*

A. spicata var. *rubra* Ait.

RED BANEBERRY

Woods and thickets. Common. June.

Actaea alba (*L.*) *Mill.*

WHITE BANEBERRY

Woods. Rare. Base of Rocky hill, southeast of Wood farm. June. The thick pedicels and white berries afford the most available characters by which to separate this species from the preceding one.

BERBERIDACEAE

Caulophyllum thalictroides (*L.*) *Mx.*

BLUE COHOSH. PAPOOSE ROOT

Rich moist soil in woods. Rare. Adirondack lodge road near Wood's sap works. May and June.

NYMPHAEACEAE

Nymphaea advena *Soland.*

Nuphar advena Ait.

YELLOW POND LILY. LARGE YELLOW POND LILY. SPATTER DOCK

Shallow water in lakes and slow flowing streams. Common. June and July.

Nymphaea hybrida *Pk.*

Nuphar advena var. *minus* Morong

RED DISK POND LILY. HYBRID POND LILY

Lakes and sluggish streams. Rare. Averyville swamp. August. This is the only locality in North Elba in which I have seen this pond lily. The stream that flows through the swamp is two or three feet deep at this place. It has a sluggish current and a soft muddy bottom. The water is very cold. No other lily was seen here. In its characters it is intermediate between the large yellow pond lily, *N. advena* Soland., and the small yellow pond lily, *N. Kalmiana* (Mx.) Sims. In 1881, a description of it was published in the *Annual report of the New York state museum* 34:53, under the name *Nuphar advena* var. *hybrida.* In 1886 it was published by Dr Morong as a distinct species to which he gave the name *Nuphar rubrodiscum.* It is *Nymphaea rubrodisca* (Morong) Greene in *Illustrated flora*, but the name required by the law of priority is here adopted. Dr Morong says that the species is intermediate between *N. advena* and *N. Kalmiana*, that it is produced from a hybrid between them and that it still is a hybrid in many localities. He gives it as an example of a good species developed from a hybrid. The *Manual*, though making it a variety of *N. advena*, admits the probability of its being a hybrid between that species and *N. Kalmiana.*

In the *Synoptical flora* the statement is made that it is with little doubt of hybrid origin and that it is frequently associated with the parent plants, growing in more shallow water than *N. advena* and often showing imperfect pollen, as though only partially fertile. I have found it in water from 2 to 6 ft deep.

The white water lily or sweet scented water lily, *Castalia odorata* (Dryand) W. & W. occurs in many of the lakes of the Adirondack region, but I have not seen it in North Elba.

Brasenia purpúrea (*Mx.*) *Casp.*

B. peltata Pursh

WATER SHIELD. WATER TARGET

In shallow water. Lake Placid and Connery pond. The peltate leaves afford an available mark of distinction between this and other aquatic plants of this region. The jelly-like coating of the submerged parts of the plant is also a peculiar feature. It is sometimes supposed to be a small purple flowered water lily.

SARRACENIACEAE

Sarracenia purpurea *L.*

PITCHER PLANT. HUNTER'S CUP. SIDE SADDLE FLOWER

Swamps and peat bogs. Raybrook, Averyville swamp and Little Cherrypatch pond. This singular plant is not abundant in any of these localities. The peat bogs, in which it delights, are gradually becoming more firm and more fully occupied by small shrubs and evergreen trees and the pitcher plant is slowly yielding to these unfavorable conditions and becoming more scarce than formerly. The hollow inflated petioles are generally partly filled with water in which drowned insects are often found.

FUMARIACEAE

Bicuculla Cucullaria (*L.*) *Millsp.*

Dicentra Cucullaria DC.

DUTCHMAN'S BREECHES. SOLDIER'S CAP

Rich soil in woods. Rare. Adirondack lodge road. May. The leaves of this and the following species are finely divided, of a glaucous hue, very glabrous and beautiful, but they soon wither and disappear.

Bicuculla Canadensis (*Goldie*) *Millsp.*

Dicentra Canadensis DC.

SQUIRREL CORN

Growing with the preceding species and closely resembling it, but the two flower spurs are much shorter and more blunt. Its yellow grain-like tubers are suggestive of the common name.

Capnoides sempervirens (*L.*) *Borck.*

Corydalis glauca Pursh

PALE CORYDALIS. PINK CORYDALIS

Rocky places; often where fire has been and on rocks covered by thin vegetable mold. Not rare. June to August.

A form having white flowers was collected on the top of Altar mountain, commonly known as Cobble hill or Cobble mountain.

CRUCIFERAE

Cardamine Pennsylvanica *Muhl.*

PENNSYLVANIAN BITTER CRESS

Swamps, streams and wet places. Common and variable. June. At South Meadow a small much branched but few flowered form was found.

Cardamine parviflora *L.*

C. hirsuta sylvatica Gray

SMALL FLOWERED BITTER CRESS

Thin soil on rocks. Cascade lake near the eastern line of the town. July. Very rare.

Arabis laevigata (*Muhl.*) *Poir.*

Thin woods and clearings. Rare. Allen farm. June.

Roripa Armoracia (*L.*) *Hitchc.*

Nasturtium Armoracia Fries

HORSERADISH

Wet places. Lake Placid. June and July. Introduced and sometimes cultivated, but well established as a wild plant.

Barbarea Barbarea (*L.*) *MacM.*

B. vulgaris var. *arcuata* Gray

YELLOW ROCKET. WINTER CRESS

Head of Cascade lake. June. This is the only locality in North Elba in which I have seen it.

Sisymbrium officinale (*L.*) *Scop.*

HEDGE MUSTARD

In gardens and waste places about dwellings. Raybrook and Lake Placid. August. An introduced plant.

Brassica arvensis (*L.*) *B. S. P.*

B. Sinapistrum Boiss.

CHARLOCK. WILD MUSTARD

Introduced and troublesome in fields of grain, specially in fields of oats. Not abundant in North Elba.

Brassica campestris *L.*

TURNIP

Introduced and cultivated but occasionally spontaneous in fields. Allen farm.

Brassica Napus *L.*

RAPE

With the preceding and closely resembling it but distinguished from it by having the base of its upper leaves auricled or sagittate.

Bursa Bursa-pastoris (*L.*) *Britton*

Capsella Bursa-pastoris Moench

SHEPHERD'S PURSE

Gardens, fields and waste places. Very common. Flowering specimens of this introduced and annoying weed may be found from early spring to late autumn. The clustered basal leaves of the young plant bear some resemblance to those of the dandelion and are sometimes mistaken for them by inexperienced persons.

Dentaria diphylla *Mx.*

TWO LEAVED TOOTHWORT. CRINKLE ROOT

Wet or damp places. Rare. Old Keene road. June.

Draba incana arabisans (*Mx.*) *Watson*

TWISTED WHITLOW GRASS

Thin soil on rocks. Rare. Indian pass, its only known locality in the town and not plentiful there. It was in fruit in August. In *New York state flora* it is given specific value and bears the name *Draba arabisans* Mx.

Lepidium Virginicum *L.*

WILD PEPPER GRASS

Introduced and growing in waste places and by roadsides. Raybrook. August.

Lepidium apetalum *Willd.*

APETALOUS PEPPER GRASS

Pastures and roadsides. Wood farm. August.

VIOLACEAE

VIOLA

Acaulescent	1
Caulescent	4
1 Flowers blue or violet	2
1 Flowers some other color	3
2 Leaves deeply cleft or lobed	palmata
2 Leaves entire	obliqua
3 Flowers yellow	rotundifolia
3 Flowers white	blanda
4 Flowers blue, plant glabrous	Labradorica
4 Flowers blue, plant puberulent	arenaria
4 Flowers yellow	scabriuscula
4 Flowers white or nearly so	Canadensis

Viola palmata *L.*

PALMATE VIOLET. EARLY BLUE VIOLET

Very rare. A few plants were seen by the side of the road to Epps farm a short distance south of the main road. They were not in flower.

Viola obliqua *Hill*

V. palmata cucullata Gray

COMMON BLUE VIOLET. MEADOW VIOLET

Meadows, pastures and roadsides. Very common. June. C. L. Pollard who has recently made a revision of the acaulescent blue violets has reached the conclusion that this common species is not the true *V. obliqua* Hill, but an undescribed species to which he has given the name *Viola communis*. The hooded violet, *V. cucullata* Ait., which has generally been regarded as specifically the same as this and which occurs in the southern part of Essex county, may yet be found in some of the swamps or wet places in North Elba. It may be known by its broader paler leaves, its paler flowers raised above the leaves by their long peduncles and by the slender erect peduncles of the cleistogamous flowers.

Viola blanda *Willd.*

Sweet white violet

Moist or wet ground in fields, swamps and ditches. Very common. June.

V. blanda amoena (*LeConte*) *B. S. P.*

V. blanda var. *palustriformis* Gray

This variety has the leaves larger than in the typical form and they are generally more or less rugose and hairy. The flowers also are larger and supported on longer peduncles.

Viola rotundifolia *Mx.*

Round leaved violet

Woods and open places. Adirondack lodge road. May. The leaves are small at flowering time but they become large with age.

Viola Labradorica *Schrank*

V. canina var. *Muhlenbergii* Gray

American dog violet

Pastures and clearings. Common. June. The long spur violet, *V. rostrata* Pursh, which is often associated with this species in other places was not detected here.

Viola arenaria *DC.*

Sand violet

Sandy soil. Pastures and clearings. June. Distinguished from the preceding species, to which it is closely related, by its puberulence and its comparatively longer and more tapering spur.

Viola scabriuscula (*T. & G.*) *Schw.*

V. pubescens var. *scabriuscula* T. & G.

Smoothish yellow violet

Rich soil in woods. Rare. Adirondack lodge road. June. The pubescent yellow violet, *V. pubescens* Ait., of which this species has been considered a variety, affords another example of an absent species which might be expected to occur here. It often grows in the same places as the smoothish yellow violet.

Viola Canadensis *L.*

Canada violet

Rare. It just enters the town at the head of Cascade lake. Its petals sometimes assume a purplish hue when old.

CARYOPHYLLACEAE

Dianthus barbatus *L.*

SWEET WILLIAM

Roadsides and waste places about houses. Introduced and cultivated for ornament but sometimes escaping from gardens and door yards. Freemans Home. July.

Silene noctiflora *L.*

NIGHT FLOWERING CATCH FLY

Waste places. Not common. Introduced.

Arenaria Groenlandica (*Retz.*) *Spreng.*

GREENLAND SANDWORT. MOUNTAIN SANDWORT

Summit of Mt McIntyre and Mt Wright. July and August.

Alsine media *L.*

Stellaria media Sm.

COMMON CHICKWEED

This introduced plant and troublesome weed is common and variable. A small upright form is common along the old Keene road in the eastern part of the town. In rich partly shaded ground it grows much larger and is either erect or prostrate. It is very hardy and may be found in blossom till freezing weather stops its growth, and in early spring it is ready to begin its growth as soon as ice and snow have disappeared.

Alsine longifolia (*Muhl.*) *Britton*

Stellaria longifolia Muhl.

LONG LEAVED STITCHWORT

Moist ground. Wood farm and Notch road. August. The species is easily recognized by its long narrow leaves and by its inflorescence soon becoming lateral.

Alsine borealis (*Bigel.*) *Britton*

Stellaria borealis Bigel.

NORTHERN STITCHWORT

Wet places. June and July. Freemans Home and Marcy trail. It ascends to the open summit of Mt Marcy. A very diffuse form approaching ***A. borealis alpestris*** was collected many years ago in the Ausable valley.

Cerastium vulgatum *L.*

LARGER MOUSE EAR CHICKWEED

Fields, waste places and roadsides. Very common. Introduced and a weed in gardens. June to September.

Spergula arvensis *L.*

SPURRY. CORN SPURRY

Gardens and fields. Raybrook and Lake Placid. August.

PORTULACACEAE

Portulaca oleracea *L.*

PURSLANE. PUSSLEY.

Gardens, cultivated ground and waste places. An introduced and very troublesome weed. It has a spreading or prostrate mode of growth where space is given but it is more erect when crowded. Its thick succulent stems and leaves make it very tenacious of life and capable of enduring prolonged dry weather. In wet weather it is useless to try to destroy it by digging it out and leaving it on the ground. It will soon take root again and continue its growth. In some parts of Europe it was formerly cultivated as a pot herb.

Claytonia Caroliniana *Mx.*

CAROLINA SPRING BEAUTY

Rich moist ground in woods and clearings. Old Keene road and Adirondack lodge road. May. The Virginia spring beauty, *C. Virginica* L., which is often associated with it and may be separated from it by its longer and more narrow leaves, probably does not occur in North Elba

HYPERICACEAE

Hypericum ellipticum *Hook.*

ELLIPTIC LEAVED ST JOHNSWORT

Wet places and shores of lakes. Marsh pond. A singular form, which is not mentioned in our botanies, is found in some parts of the Adirondack region. Its leaves are more narrow than in the ordinary form, erect and appressed to the stem.

Hypericum perforatum *L.*

COMMON ST JOHNSWORT

Fields, pastures and waysides. A common introduced weed. July and August.

Hypericum mutilum *L.*

DWARF ST JOHNSWORT

Along streams and shores and in wet places. Common. July. The species is easily recognized by the small size of the plants, the wide spreading branches, small flowers and broad ovate leaves. The Canada St Johnswort, *Hypericum Canadense* L., is common in many parts of the Adirondacks and has been collected near Wilmington notch and may yet be found in North Elba.

Triadenum Virginicum (*L.*) *Raf.*

Elodes campanulata Pursh

MARSH ST JOHNSWORT

Bogs, shores and marshes. Rare. South end of Lake Placid. July.

MALVACEAE

Malva moschata *L.*

MUSK MALLOWS

Waste places about houses or where houses once stood. Raybrook and Allen farm. August. An introduced plant cultivated in flower gardens but often escaping and growing wild.

TILIACEAE

Tilia Americana *L.*

BASSWOOD. AMERICAN LINDEN. WHITEWOOD

Newman farm is the only known station for it in the town. This farm is said to contain the highest cultivated land in the state. It is somewhat remarkable that a tree not noted for growing in elevated localities should be found only on the highest land of one of the most elevated farms in the town.

GERANIACEAE

Impatiens biflora *Walt.*

I. fulva Nutt.

SPOTTED TOUCH-ME-NOT. SILVER LEAF

Wet places. Very common. July to September. The pale touch-me-not, *I. aurea* Muhl., occurs in many parts of the Adirondack region but has not yet been found in North Elba.

Oxalis Acetosella *L.*

Wood sorrel

Woods. Very common. June and July. This plant occurs plentifully in nearly all parts of the Adirondacks and ascends to the summits of the highest peaks.

Oxalis cymosa *Small*

Tall yellow wood sorrel

Fields and waysides. Common. August. The plants are generally small and indicate adverse conditions of soil and climate. The species was formerly included with *O. stricta* L., but it has recently been separated as a distinct species. It is distinguished by its spreading pedicels and its shorter capsules. These are rarely more than half an inch long.

Geranium Robertianum *L.*

Herb robert. Red robin

Damp shaded places. Rare. Mt McIntyre. July. The wild crane's bill or spotted geranium, a common plant in most places, seems to be absent from North Elba.

ILICINEAE

Ilicioides mucronata (*L.*) *Britton*

Nemopanthes fascicularis Raf.

Mountain holly. Wild holly

Margins of lakes, swamps, mountains and wet places. Common. June. This shrub ascends to the top of Mt McIntyre. Its flowers are very small and inconspicuous, but its ripe berries are bright red and attractive in appearance though they have a disagreeable flavor and if eaten are likely to cause sickness.

SAPINDACEAE

Acer Saccharum *Marsh.*

A. saccharinum Wang.

Sugar maple. Hard maple. Rock maple.

Rich soil of hills, valleys and mountain sides. Common. May. The most valuable of our maples, both on account of its wood and of the sugar derived from its sap. It is also excellent as an ornamental shade tree. An abundance of large thrifty sugar maples in the forest is

an indication of a rich soil and the rank and vigorous growth of weeds and grasses, so often seen about sugar camps, confirms the evidence of the maples. Several species of plants noted for their fondness for rich moist soil occur about Wood's sugar camp on the Adirondack lodge road. Considerable maple sugar is made in North Elba and griddle cakes with maple syrup is a favorite article of food both of the inhabitants and of summer boarders.

Acer rubrum *L.*

RED MAPLE. SOFT MAPLE. SWAMP MAPLE

Swamps, low ground along streams and margins of lakes. Common. April and May. The red maple is a smaller tree than the sugar maple and of less value commercially. Its foliage assumes beautiful red tints in autumn and it helps make the forest appear like an immense flower garden at that season.

Acer Pennsylvanicum *L.*

STRIPED MAPLE. MOOSEWOOD. WHISTLEWOOD.

Woods and rocky places. Common. June. The smooth bark of young trees is beautifully marked with white and green stripes. The yellowish green flowers are larger than the flowers of any of the other native maples. They form beautiful drooping racemes.

Acer spicatum *Lam.*

MOUNTAIN MAPLE

Rocky places and mountain sides. Common. June. This shrub or small tree often grows in clumps. Its small pale flowers form oblong or cylindric erect spike-like clusters or racemes. The silver maple, *Acer saccharinum* L., is found in the eastern part of Essex county but is apparently wanting in North Elba. The black maple, *Acer nigrum* Mx., is also absent.

LEGUMINOSAE

Trifolium repens *L.*

WHITE CLOVER. DUTCH CLOVER

Meadows, pastures and roadsides. Common. July to September. This is the only native clover observed, and it and the tufted vetch are the only indigenous representatives of their family seen in North Elba.

Trifolium hybridum *L.*

ALSIKE CLOVER

Fields and pastures. Common. July and August. This introduced species appears to be perfectly at home here. It persists where it has been planted and stubbornly refuses to yield possession of the ground to those noxious and aggressive weeds that too often overpower and subdue useful species. I have seen it in sheep pastures, maintaining its foothold in places where it was almost surrounded by sheep sorrel. Its flowers afford good bee pasture and are sought by honey bees.

Trifolium pratense *L.*

RED CLOVER

Waysides and meadows. Common. July and August. This and alsike clover are cultivated for fodder and furnish a considerable part of the hay crop.

Trifolium agrarium *L.*

YELLOW CLOVER. HOP CLOVER

Pastures, clearings and roadsides. Occasional. It is an introduced plant but not cultivated. Its yellow flowers easily distinguish it from the other clovers.

Melilotus alba *Desv.*

WHITE MELILOT. SWEET CLOVER

Waste places and roadsides. Raybrook. August. The yellow melilot, *Melilotus officinalis* (L.) Lam., is often associated with this species. Both species often grow along railroads and the yellow melilot will probably be introduced soon. The black medic, *Medicago lupulina* L., a common introduced weed, may also be expected to make its appearance here in the near future.

Vicia sativa *L.*

COMMON VETCH. TARE

Fields and meadows. Rare. Allen farm. August.

Vicia Cracca *L.*

TUFTED VETCH. COW VETCH. BLUE VETCH

Roadsides. Scarce. Lake Placid and Newman. July.

ROSACEAE

Prunus Pennsylvanica *L.f.*

WILD RED CHERRY. PIN CHERRY

Along fences and in recent clearings and wind slashes. Common. May and June.

This is a small tree of rapid growth and short life. It springs up abundantly wherever clearings have been made in the forest. Its fruit is smaller than the fruit of our other native species and is quite acid. Its branches are often disfigured by oblong irregular black swellings commonly called black knot. These knots are caused by a parasitic fungus, *Plowrightia morbosa* (Schw.) Sacc., whose spores, lodging on the branches, germinate, under favorable conditions, and entering the newly formed tissue by means of their germinal tubes cause an unnatural enlargement of the affected part of the branch. The bark ruptures and the exposed tissue is soon covered by an olive green mold which in turn is replaced by a multitude of small crowded black globular bodies, the spore cases of the fungus. The spores escaping from these are liable to lodge on and produce the disease in any cultivated cherry or plum trees that may be growing in the vicinity, and thereby injure the fruiting capacity of these trees.

Prunus Virginiana *L.*

CHOKE CHERRY

Roadsides, clearings and along fences. Very common. June.

The choke cherry fruits abundantly but its fruit has an astringent quality that interferes with its usefulness. If this could be overcome it would be a valuable addition to our supply of hardy fruits. It is a shrub or sometimes a small tree and grows freely in all parts of the Adirondacks where clearings have been made. A dwarf form occurs in which the flowers are very small and the racemes are only an inch or an inch and a half long.

Prunus serotina *Ehrh.*

BLACK CHERRY. WILD BLACK CHERRY. RUM CHERRY

Trees of this species are scattered over nearly the whole town, growing both in the woods and in cleared lands. In the woods it makes a tall tree with a trunk suitable for lumber when sufficiently straight. It flowers in June.

Spiraea salicifolia *L.*

WILLOW LEAVED MEADOW SWEET. AMERICAN MEADOW SWEET

Very common, growing in upland and lowland, in soil wet or dry, rocky or smooth and ascending to the top of the highest Adirondack peaks. July and August. The leaves of this shrub vary greatly in size and shape. The flowers are usually white but sometimes they are tinged with pink. A dwarf form grows on the summit of Mt McIntyre. It is scarcely more than a foot high, its leaves are oval and often less than an inch long.

Spiraea tomentosa *L.*

HARDHACK. STEEPLE BUSH

Roadsides and pastures. Rare. In a pasture on the ground of the Placid club, roadside half a mile northeast of Newman and on Epps farm. August. It may be distinguished from the preceding species by its more dense clusters of pinkish flowers and by the tomentose lower surface of the leaves.

Spiraea sorbifolia *L.*

SORB LEAVED SPIRAEA

Introduced and cultivated for ornament, but escaping from cultivation. Spreading from the cemetery into the adjoining field. July.

RUBUS

Ripe fruit easily separable from the receptacle	strigosus
Ripe fruit not easily separable from the receptacle	1
1 Stems slender, trailing or ascending	2
1 Stems stout, erect or curved	3
2 Stems unarmed	Americanus
2 Stems armed with stiff bristles	setosus
2 Stems armed with hooked prickles	Canadensis
3 Stems unarmed or armed with few small prickles	Millspaughii
3 Stems armed with stout prickles	4
4 Fruit oblong or thimble shape	Allegheniensis
4 Fruit subglobose	villosus

Rubus strigosus *Mx.*

RED RASPBERRY. WILD RED RASPBERRY

Roadsides, along fences and in recent clearings. Very common. June and July. The red raspberry is perfectly at home in this region and bears plentiful crops of fine fruit. The wild berries are so abundant that little need is felt of spending time and labor in efforts to cultivate this fruit. It ripens in North Elba three or four weeks later than in the

vicinity of Albany. The plant grows on the summit of Mt McIntyre but I have not seen it in fruit there. The climatic conditions are probably too severe for it.

Rubus Americanus (*Pers.*) *Britton*

R. triflorus Richards.

DWARF RASPBERRY

Swamps and wet places. Common. June. The fruit is not plentiful but it has an agreeable flavor. It separates from the receptacle with some difficulty and has by some been considered a blackberry on this account, though in other respects its affinities are with the raspberries.

R. Americanus roseiflorus *Pk.*

This variety differs from the typical form in having pink or rose colored flowers. I have found it in woods only. Adirondack lodge and Wood's sap works.

Rubus Canadensis *L.*

LOW BLACKBERRY. RUNNING BLACKBERRY. DEWBERRY

Pastures and roadsides. Wood farm. June.

Rubus setosus *Bigel.*

BRISTLY BLACKBERRY

Roadsides, pastures and clearings in soil either wet or dry. Raybrook and in the eastern part of the town. July. In this species the stem is generally densely armed with short stiff bristles. Its fruit is small and similar to that of the preceding species, but inferior to that of the three following. The species is apparently limited in our state to the Adirondack region, where it seems to take the place of the running blackberry, *R. hispidus* L.

Rubus Millspaughii *Britton*

MILLSPAUGH'S BLACKBERRY

Roadsides, thickets and thin woods. Common. July. The species is distinguished by being almost or entirely glabrous and in having the stem unarmed or bearing only a few weak prickles.

Rubus Allegheniensis *Porter*

MOUNTAIN BLACKBERRY

Hillsides and thickets. Best separated from the following species by the fruit which is oblong or thimble shape, less pulpy, with smaller seeds and drupelets and a peculiar rich and agreeable flavor.

Rubus villosus *Ait.*

BLACKBERRY. HIGH BUSH BLACKBERRY

Clearings and thickets. Lake Placid. July.

R. villosus frondosus *Bigel.*

This variety differs from the typical form in being less glandular and in having shorter racemes with fewer flowers.

The black raspberry, *R. occidentalis* L., is not yet known to occur in the town. The beautiful purple flowering raspberry, *R. odoratus* L., is found at Cascade lake a few rods beyond the town line, but it was not seen within the town limits.

Geum Canadense *Jacq.*

G. album Gmelin

WHITE AVENS

Thin woods and shaded places. Abundant along the old Keene road. August.

Geum strictum *Ait.*

YELLOW AVENS

Pastures and roadsides. Common. August.

Geum macrophyllum *Willd.*

LARGE LEAVED AVENS

Low moist ground and in shaded places. Common in the eastern part of the town. Old Keene road, head of Cascade lake and west of Freemans Home. June.

Geum rivale *L.*

PURPLE AVENS. WATER AVENS

Swamps and wet places. Common. June and July. Easily known by its large nodding purplish flowers.

Dalibarda repens *L.*

DALIBARDA

Woods and mossy places. Common. July and August.

Fragaria Virginiana *Duchesne*

STRAWBERRY. VIRGINIA STRAWBERRY

Fields and pastures. Common. May and June.

Fragaria Americana (*Porter*) *Britton*

AMERICAN WOOD STRAWBERRY

Woods and open places. Head of Cascade lake. June.

POTENTILLA

	Plant herbaceous	1
	Plant shrubby	fruticosa
1	Leaflets three	2
1	Leaflets five	3
2	Leaflets with teeth at the apex only	tridentata
2	Leaflets with teeth on the margin	Monspeliensis
3	Leaflets narrow, deeply cleft	argentea
3	Leaflets broad, coarsely serrate	Canadensis

Potentilla fruticosa *L.*

SHRUBBY CINQUEFOIL

Top of Mt Wallface. A single clump of small unthrifty sterile plants was found, and these at present are the only known representatives of the species in the town.

Potentilla tridentata *Soland.*

THREE TOOTHED CINQUEFOIL

Mountain tops. Mt McIntyre and Mt Wright. July and August.

Potentilla Monspeliensis *L.*

P. Norvegica L.

ROUGH CINQUEFOIL

Meadows and roadsides. Very common. June to August.

Potentilla argentea *L.*

SILVERY CINQUEFOIL

Dry soil. Rare. Raybrook. July and August.

Potentilla Canadensis *L.*

FIVE FINGER

Dry soil. Roadsides and pastures. June. Seen only in the eastern part of the town.

Comarum palustre *L.*

Potentilla palustris Scop.

MARSH FIVE FINGER. MARSH CINQUEFOIL

Bogs, swamps and sluggish streams. Occasional. Near Raybrook and between Freemans Home and Wood farm.

Agrimonia hirsuta (*Muhl.*) *Bicknell*

TALL HAIRY AGRIMONY

Roadsides and thickets, specially along old lumber roads in woods Common. August. In the *Manual* included in *Agrimonia Eupatoria* L.

Rosa cinnamomea *L*

CINNAMON ROSE

Introduced and cultivated for ornament, but sometimes escaping from cultivation or spreading by root extension, or lingering in places where dwellings once stood. Spreading from the cemetery. By the roadside a few rods south of Brewster's sawmill.

Sorbus Americana *Marsh.*

Pyrus Americana DC.

MOUNTAIN ASH. AMERICAN MOUNTAIN ASH.

Woods and their borders. Common. June and July.

Sorbus sambucifolia (*C. & S.*) *Roem.*

Pyrus sambucifolia C. & S.

ELDER LEAF MOUNTAIN ASH. WESTERN MOUNTAIN ASH

Cold woods and mountains. Summit of Mt McIntyre and at the entrance of Peck pass. June. This species is much less frequent than the preceding, from which it is separated by its more coarsely serrate and less sharply pointed leaves. It also blossoms earlier than that species. A tree standing near the entrance to Peck pass was in full flower when one of the American mountain ash standing a few rods away was in bud and apparently would not be in flower in two weeks.

Malus Malus (*L.*) *Britton*

Pyrus Malus L.

APPLE

Introduced and cultivated for its fruit, but often growing spontaneously by roadsides, along fences and in pastures and clearings. Near Brewster's mill, along the road to Epps farm and in several places in the Ausable valley.

Aronia nigra (*Willd.*) *Britton*

Pyrus arbutifolia var. *melanocarpa* Hook.

BLACK CHOKEBERRY

Wet or dry soil. Common. June. It ascends to the top of Mt Wright but was not found on Mt McIntyre. It also inhabits cold swamps.

The red chokeberry, *Aronia arbutifolia* (L.) Ell., in some localities is associated with this species, from which it differs in having red fruit and leaves densely tomentose on the lower surface.

Crataegus coccinea *L.*

SCARLET THORN. RED HAW

Along roadsides and fences and in pastures. Very common. June. Several forms or varieties occur. In one, the leaf blade is acute at the base and the petiole is shorter than in the typical form. This form approaches *C. coccinea flabellata* (Spach) Britton and is perhaps referable to it. In another, the thorns are longer than usual and indicate an approach to *C. macracantha* Lodd.

Crataegus punctata *Jacq.*

LARGE FRUITED THORN

Rare. The only representatives seen are two trees standing in a pasture a short distance southeast of Mountain View house. They are united at the base and each has a trunk diameter of about 10 inches just above the place of union.

Amelanchier Canadensis (*L.*) *Medic.*

SHAD BUSH. SERVICE BERRY

Borders of woods and clearings. Common. May.

Amelanchier rotundifolia (*Mx.*) *Roem.*

ROUND LEAVED JUNEBERRY

Roadsides and clearings. Occasional. Raybrook and near Brewster's mill.

Amelanchier spicata (*Lam.*) *DC.*

LOW JUNEBERRY

In rocky places and in dry sandy soil. Our smallest species. In a pasture on the Placid club grounds there is a small form scarcely more

than a foot high, yet it blossoms and bears fruit freely. Larger forms occur near Newman farm and at South Meadow. In the small form the leaves are often quite as round as those of the preceding species, but they are much smaller and rather coarsely toothed above only, being entire toward the base. The young leaves are densely woolly beneath.

Amelanchier oligocarpa (*Mx.*) *Roem.*

OBLONG FRUITED JUNEBERRY. FEW FRUITED JUNEBERRY.

Mountains and cool valleys. Not rare. June. Fruit ripe in July and August. A very distinct species flowering later than the others and bearing fruit of a peculiar shape. The fruit of all the species is edible when ripe. In this species the flowers are scattered or only two or three in a cluster and generally but one or two fruits of a cluster mature. Its leaves are finely serrate and have short petioles.

SAXIFRAGACEAE

Saxifraga Virginiensis *Mx.*

EARLY SAXIFRAGE

Rocky or springy places. Pulpit rock and Indian pass. May.

Mitella nuda *L.*

NAKED BISHOP'S CAP

Cool woods and swamps. Rare. Swampy woods east of Wood farm. Woods along the west side of the Ausable near Wood farm. June.

Mitella diphylla *L.*

TWO LEAVED BISHOP'S CAP. MITREWORT

Woods. Rare. Old Keene road. June.

Tiarella cordifolia *L.*

FALSE MITREWORT. COOLWORT

Moist shady places in woods and clearings. Common. June. Two noticeable forms occur, both differing from the common form. In one, the leaves are obscurely streaked with brown along the principal veins; in the other, they are bright green and shining.

Chrysosplenium Americanum *Schw.*

GOLDEN SAXIFRAGE. WATER CARPET

Wet places. Occasional. Woods between the south end of Lake Placid and Newman. Banks of the Ausable above Brewster's mill.

RIBES

	Flowers in racemes	1
	Flowers not in racemes	2
1	Stems armed with stiff bristles	lacustre
1	Stems unarmed	prostratum
	2 Fruit prickly	Cynosbati
	2 Fruit smooth	3
3	Flowers 2–3 lines long, stamens included	oxyacanthoides
3	Flowers 3–4 lines long, stamens exserted	rotundifolia

Ribes lacustre (*Pers.*) *Poir.*

SWAMP GOOSEBERRY

Swamps and wet places. Common. June.

Ribes prostratum *L'Her.*

FETID CURRANT

Damp woods and rocky places. Common. June. This species ascends nearly to the top of Mt McIntyre. Its stems are not always prostrate as the specific name might indicate. The peculiar odor of the plant is characteristic and is specially perceptible if the plant is bruised or broken.

Ribes Cynosbati *L.*

WILD GOOSEBERRY. DOGBERRY

Thin woods and bushy places. Common. June and July. The ripe fruit is edible, but the prickly skin should be discarded.

Ribes oxyacanthoides *L.*

NORTHERN GOOSEBERRY

Woods and moist places. Rare. Old Keene road. June.

Ribes rotundifolium *Mx.*

ROUND LEAVED GOOSEBERRY

Woods and open places. Occasional. June. Resembling the preceding species but distinguished from it by the longer flowers, linear sepals and exserted stamens. Both have the fruit smooth and edible.

CRASSULACEAE

Sedum Telephium *L.*

LIVE-FOR-EVER. ORPINE

Introduced. Occasional. Very tenacious of life.

DROSERACEAE

Drosera rotundifolia *L.*

ROUND LEAVED SUNDEW

Wet or muddy places. Scarce. By the side of the road to Epps farm a few rods south of the main road. Bogs in the south end of Lake Placid. July. A favorite habitat is on decaying trunks of trees lying in water. The glandular tipped hairs of the leaves shine like dewdrops in the sun.

HALORAGEAE

Myriophyllum tenellum *Bigel.*

SLENDER WATER MILFOIL

Muddy shores. Very rare. Marsh pond. July. In the summer of 1880 the water in this pond was very low and this little plant was so abundant on the muddy shore as to attract attention from a distance by its peculiar yellowish brown color.

Hippuris vulgaris *L.*

BOTTLE BRUSH. JOINTWEED. MARES TAIL

Shallow water. Very rare. Chubb river in Averyville swamp. August The flower of this plant is minute and inconspicuous. It furnishes an example of great simplicity of structure. There is a trace of a calyx but no corolla and but one stamen and one pistil in a flower, and one seed in a single celled ovary.

Callitriche palustris *L.*

C. verna L.

WATER FENNEL. VERNAL WATER STARWORT

In water and on mud. Occasional. Raybrook and old Keene road. In both places it was growing on mud.

ONAGRACEAE

Isnardia palustris *L.*

Ludwigia palustris L.

WATER PURSLANE

Wet places. Rare. Woods between the south end of Lake Placid and Newman

Chamaenerion angustifolium (*L*) *Scop.*

Epilobium angustifolium L.

GREAT WILLOW HERB. FIREWEED

Recent clearings and specially in places recently overrun by fire. Common. July and August. A form sometimes occurs in which the flowers are white.

Epilobium lineare *Muhl.*

LINEAR LEAVED WILLOW HERB

Bogs and swamps. Wood farm swamp. June and July.

Epilobium adenocaulon *Haussk.*

NORTHERN WILLOW HERB

Moist or wet ground. Common. July and August. Hornemann's willow herb, *Epilobium Hornemanni* Reich., occurs along the trail to Mt Marcy not far beyond the east line of the town and may yet be found within the town limits.

Onagra biennis (*L.*) *Scop.*

OEnothera biennis L.

COMMON EVENING PRIMROSE

Pastures and clearings. Common. August.

Onagra cruciata (*Nutt.*) *Small*

OEnothera biennis var. *cruciata* T. & G.

SMALL FLOWERED EVENING PRIMROSE

Roadsides. Rare. Near Brewster's mill. August. Separated from the preceding species by its much shorter and narrower petals.

Kneiffia pumila (*L.*) *Spach*

OEnothera pumila L.

DWARF EVENING PRIMROSE. SMALL SUNDROPS

Pastures and roadsides in wet or dry soil. Common. July.

Circaea alpina *L.*

SMALLER ENCHANTER'S NIGHTSHADE

Moist soil in woods and along streams. Common. August.

CUCURBITACEAE

Micrampelis lobata (*Mx.*) *Greene*

Echinocystis lobata T. & G.

WILD BALSAM APPLE

Waste places. Rare. Lake Placid. August. An annual climbing vine which is sometimes cultivated for ornament and shade.

UMBELLIFERAE

Heracleum lanatum *Mx.*

COW PARSNIP

Roadsides. Near the Notch house and near Brewster's mill. July and August. It sometimes grows in thin woods. It is a tall, coarse, unattractive plant.

Pastinaca sativa *L.*

WILD PARSNIP

Along fences and roadsides. Occasional. John Brown farm. Introduced. Specifically the same as the cultivated parsnip.

Zizia aurea (*L.*) *Koch*

GOLDEN MEADOW PARSNIP

Dry ground, roadsides and pastures. Rare. Near Mountain View house. June.

Carum Carui *L.*

CARAWAY

About dwellings and in meadows. Common. Introduced and thoroughly naturalized. June and July.

Cicuta bulbifera *L.*

BULBIFEROUS WATER HEMLOCK

Swamps and wet places. Common. July and August. The roots of this plant and of its near relative, the water hemlock, *C. maculata* L., are poisonous.

Osmorrhiza Claytoni (*Mx.*) *B. S. P.*

O. brevistylis DC.

SWEET CICELY. SPURIOUS SWEET CICELY

Woods and their borders. Occasional. John Brown farm and about Wood's sap works. June.

Hydrocotyle Americana *L.*

AMERICAN MARSH PENNYWORT

Wet ground. Common. The wild carrot, *Daucus Carota* L., is an annoying weed in many places, but North Elba has hitherto escaped its invasion, though the cultivated form is often seen in gardens.

ARALIACEAE

Aralia hispida *Vent.*

BRISTLY SARSAPARILLA. WILD ELDER

Pastures and clearings. Common. June.

Aralia nudicaulis *L.*

WILD SARSAPARILLA

Woods and recent clearings. Common. June.

CORNACEAE

Cornus Canadensis *L.*

DWARF CORNEL. SUGARBERRY. BUNCHBERRY

Woods, pastures and mountain tops. Very common. June and July. This hardy little plant is abundant in nearly all parts of the Adirondacks. It readily adapts itself to a great variety of soil and situation. Its dense clusters of bright scarlet berries are very attractive and are edible when ripe.

Cornus stolonifera *Mx.*

RED OSIER. WHITEBERRY DOGWOOD

Shores of lakes and streams, swamps and wet places. Common June. The ripe fruit may be white or pale lead color.

Cornus alternifolia *L. f.*

ALTERNATE-LEAVED DOGWOOD

Along roadsides and fences. Common. July. Less frequent than the preceding. Its ripe fruit is blue.

CAPRIFOLIACEAE

Sambucus Canadensis *L.*

ELDER. SWEET ELDER

Roadsides and banks of streams. Common. July. The flowers of this shrub furnish the old time domestic medicine, elder blow tea. Its ripe fruit is sometimes employed in making pies and wine. Perhaps the plant may be worthy of cultivation for the sake of its flowers and fruit.

Sambucus pubens *Mx.*

S. racemosa L.

REDBERRY ELDER

Rocky places and clearings. Very common. May and June. In some places this is known as poison elder, but it is not probable that the fruit is poisonous. When ripe it has a beautiful bright red or scarlet color, but its flavor is disagreeable.

Viburnum cassinoides *L.*

WITHE ROD

Swamps and wet places. Very common and variable. It sometimes bears fruit when only one or two feet high.

Viburnum alnifolium *Marsh.*

V. lantanoides Mx.

WITCH HOBBLE. WAYFARING TREE

Woods. Very common. May. This is one of the prevailing shrubs of the Adirondacks. It delights to grow in the shade of woods and quickly disappears if deprived of their protection. Its fruit is black when fully ripe and then has an agreeable flavor and is edible, but the pulp is thin and the pit comparatively large. The flowers sometimes assume a pink or rosy red hue when old.

The high cranberry or high bush cranberry, *Viburnum Opulus* L., is an inhabitant of some parts of the Adirondack region. It is growing

by the roadside near the upper iron bridge over the Ausable and near Mountain View house, but was probably planted in both these places.

Linnaea borealis *L.*

TWIN FLOWER

Mucky soil and mossy ground in woods and clearings. Common. July. This beautiful little creeping evergreen ascends to the top of Mt McIntyre and endures the cool air of Indian pass.

Lonicera ciliata *Muhl.*

FLY HONEYSUCKLE

Woods and their borders. Common. June. A singular form of this small shrub was found on the trail of Indian pass. Its leaves are oblong and the fruit is in clusters of four or more berries united in a mass at the end of the peduncle.

Lonicera coerulea *L.*

MOUNTAIN FLY HONEYSUCKLE

Summit of Mt McIntyre. Rare. June.

Lonicera hirsuta *Eaton*

HAIRY HONEYSUCKLE

Bushy places. Occasional. Raybrook and Notch road. July.

Diervilla Diervilla (*L*) *MacM.*

D. trifida Moench

BUSH HONEYSUCKLE

Roadsides and clearings. Occasional. In the Ausable valley. July.

RUBIACEAE

Houstonia coerulea *L.*

BLUETS. INNOCENCE

Pastures, roadsides, banks of streams and mountain tops. Very common. May to July. This pretty little plant sometimes forms such extensive patches as to give color to large areas by reason of the multitude of its small pale blue flowers. A form bearing white flowers sometimes occurs.

Mitchella repens *L.*

PARTRIDGE BERRY

Dry ground. Rare. Near Mountain View house. July. The flowers of this creeping evergreen vine are produced in pairs, the ovaries of which are united and form a single red berry, which is edible.

Galium boreale *L.*

NORTHERN BEDSTRAW

Fields and waste places. Rare. Allen farm. July.

Galium trifidum *L.*

SMALL BEDSTRAW

Swamps and low wet ground. Common. July and August. The specific name is suggested by the flowers which are three parted.

Galium asprellum *Mx.*

ROUGH BEDSTRAW

Wet places and banks of streams. Common. August.

Galium triflorum *Mx.*

SWEET SCENTED BEDSTRAW

Woods and open places. Common. July. The northern wild liquorice, *Galium Kamtschaticum* Stellar, is reported to have been found in Indian pass many years ago, but as I failed to find it in my recent exploration of that locality it is omitted. It occurs along the trail to Mt Marcy one or two miles beyond the town line.

COMPOSITEA

Eupatorium purpureum *L*

TRUMPET WEED. JOE PYE WEED

Wet or dry ground, roadsides and along streams. Common. July and August.

Eupatorium ageratoides *L.*

WHITE SNAKEROOT

Woods or moist shaded places. Rare. Indian pass. August.

SOLIDAGO

	Flower heads clustered in the axils of the leaves or forming a narrow spike-like panicle, not secund	1
	Flower heads on spreading or recurved branches, forming a corymbose panicle, secund	6
1	Flower heads, 3-4 lines long	2
1	Flower heads less than 3 lines long	4
2	Leaves ovate, acuminate	macrophylla
2	Leaves not ovate	3
3	Stems less than 1 foot long, plant alpine	alpestris
3	Stems more than 1 foot long, plant not alpine	Virgaurea
4	Leaves ovate, acuminate, sharply serrate	flexicaulis
4	Leaves oblong or lanceolate	5
5	Stem glabrous	uliginosa
5	Stem puberulent	puberula
6	Leaves triple nerved	Canadensis
6	Leaves not triple nerved	7
7	Stem and leaves hairy	rugosa
7	Stem and leaves glabrous	arguta

Solidago macrophylla *Pursh*

LARGE LEAVED GOLDENROD

Damp or mossy ground in woods and open places. Common. August. This beautiful goldenrod is plentiful near the tops of the mountains, growing luxuriantly in the damp mossy ground under the balsam firs that abound in such places. It also ascends to the open summits of the highest peaks and descends into the valleys. It is not rare in the valley of the Ausable.

Solidago alpestris *W. & K.*

S. Virgaurea var. *alpina* Bigel.

ALPINE GOLDENROD

Summit of Mt McIntyre and Mt Wright, also on the side of Wallface mountain. August. The flower heads are large in proportion to the size of the plant. The plants are generally 6 to 10 inches high but the flower heads are nearly as large as in the preceding species.

Solidago Virgaurea *L.*

GOLDENROD

Rocky places. Pulpit rock. August. This is the only locality for it in North Elba so far as known, the following variety being excepted.

S. Virgaurea Redfieldii *Porter*

Massive mossy rocks. Indian pass.

Solidago flexicaulis *L.*

S. latifolia L.

BROAD LEAVED GOLDENROD

Damp ground. Rare. Bank of the Ausable near H. Brown farm, and at the head of Cascade lake. August. The leaves resemble to some extent those of the large leaved goldenrod, but they are more pointed at the base. The flower heads are much smaller.

Solidago uliginosa *Nutt.*

WILLOW LEAVED GOLDENROD

Swamps and wet places, rarely on dry ground. Occasional. In a marsh southeast of Raybrook. August.

Solidago puberula *Nutt.*

PUBERULENT GOLDENROD

Sandy hillocks about half a mile southeast of Raybrook. August. Rare in North Elba, but very abundant in the sandy region between Rainbow station and Rainbow lake.

Solidago Canadensis *L.*

CANADIAN GOLDENROD

Pastures, clearings, roadsides and along fences. Very common and variable in size. August.

S. Canadensis glabrata *Porter*

With the typical form.

Solidago rugosa *Mill.*

HAIRY GOLDENROD

Roadsides, fence rows and clearings. Common. August.

Solidago arguta *Ait.*

SHARP TOOTHED GOLDENROD

Woods and open places. Very common. July and August. It begins to blossom earlier than the other goldenrods of this region.

It is nearly as early as *S. juncea* Ait. which does not appear in North Elba, but which is plentiful in the neighboring town of Jay. *S. squarrosa* Muhl. occurs just over the line at Cascade lake and may be expected

to appear in the eastern part of the town in the near future. *S. bicolor* L., *S. caesia* L. and *S. nemoralis* Ait. are found in adjacent regions and may yet be found in North Elba.

Euthamia graminifolia (*L.*) *Nutt.*

Solidago lanceolata L.

BUSHY GOLDENROD

Fields and low grounds. Common. August.

ASTER

Ray flowers blue or violet purple	1
Ray flowers white	3
1 Leaves ovate, lower and basal ones petiolate	macrophyllus
1 Leaves oblong or linear lanceolate	2
2 Stem rough with coarse hairs	puniceus
2 Stem glabrous or slightly hairy above	Novi-Belgii
3 Leaves oblong, acuminate, more than 6 lines wide	acuminatus
3 Leaves linear or narrowly lanceolate, less than 6 lines wide	Tradescanti

Aster macrophyllus *L.*

LARGE LEAVED ASTER

Woods and banks of streams. Rare. Notch road. August.

A. macrophyllus cymosulus *Burgess*

Banks of the Ausable on Wood farm. In the *Manual* this species is made to include plants having white rays, but in *Illustrated flora* it is limited to those having colored rays. I have seen no forms with white rays in the elevated parts of the Adirondacks. The absence of these seems to support the limitation of the species to the forms having blue rays.

Aster puniceus *L.*

RED STEM ASTER

Along streams, in swamps and wet places. Very common. August and September. This is the earliest flowering aster of this region. It is very variable in size, aspect, length and breadth of its leaves.

Aster Novi-Belgii *L.*

NEW BELGIAN ASTER

Along the Ausable river above the upper iron bridge. August and September. Separated from the preceding species by its more narrow leaves and smooth stem. The two species seem to run together.

Aster acuminatus *Mx.*

ACUMINATE ASTER

Wet or moist soil in woods and open places. Common and variable. August and September. In poor soil and in elevated exposed situations the plants are small, having short stems, few leaves and few flower heads.

Aster Tradescanti *L.*

TRADESCANT'S ASTER

Along the railroad near Raybrook. September.

Doellingeria umbellata (*Mill.*) *Nees*

Aster umbellatus Mill.

UMBELLED ASTER

Wet or dry soil. Common. August. The species varies much in size and aspect. A small form occurs along the bushy banks of streams. It often projects over the water and spreads its leaves laterally in such a way as to cause them to appear somewhat two ranked.

Erigeron Canadensis *L.*

HORSEWEED. BUTTERWEED

Pastures and clearings. Very common and very variable in size. Ranging from 6 inches to 6 feet high.

Erigeron ramosus (*Walt.*) *B. S. P.*

E. strigosus Muhl.

DAISY FLEABANE

Meadows and pastures. Common. June to August. Its usual associate, *E. annuus* (L.) Pers., is absent from North Elba.

Antennaria plantaginifolia (*L.*) *Rich.*

PLANTAIN LEAF EVERLASTING

Poor dry soil. Common. May and June.

Antennaria margaritacea (*L.*) *Hook.*

Anaphalis margaritacea B. & H.

PEARLY EVERLASTING

Dry ground in pastures and by roadsides. Common. August.

Gnaphalium uliginosum *L.*

LOW CUDWEED

Low ground and roadsides. Common. August.

Rudbeckia hirta *L.*

HAIRY RUDBECKIA

Meadows and pastures. Common. July and August. This is sometimes called yellow daisy. It is a rival of the white daisy and an unwelcome weed in meadows.

Achillea Millefolium *L.*

YARROW. MILFOIL

Waysides and fields. Very common. August. Introduced. A pink flowered variety is sometimes cultivated in flower gardens and occasionally escapes and grows in waste places and by roadsides.

Chrysanthemum Leucanthemum *L.*

WHITE DAISY. OX EYE DAISY

Abundant. June to August. A pernicious weed in meadows, but one which readily yields to cultivation. Introduced.

Tanacetum vulgare *L.*

TANSY

Roadsides and waste places about houses. Introduced and sometimes planted.

Arnica Chamissonis *Less.*

SOFT ARNICA

Along mountain streams. July and August. Many years ago I collected specimens of this plant about a mile north of Indian pass. It was growing by the side of the stream that flows northward from the pass. I have not since that time seen it growing in North Elba, but retain it in the list because it may possibly yet exist about some of the head waters of that stream or in the unexplored southwestern part of the town.

Senecio aureus *L.*

GOLDEN RAGWORT. SQUAWWEED

Swamps and wet places. Not common. Averyville swamp. July.

Senecio Robbinsii *Oakes*

ROBBIN'S RAGWORT

In wet or dry soil. Common. July.

Erechtites hieracifolia *L.*

FIREWEED

Borders of woods and clearings, specially in places overrun by fire. Wood farm. August.

Arctium Lappa *L.*

BURDOCK

Roadsides and waste places about dwellings. Lake Placid.

Carduus lanceolatus *L.*

Cnicus lanceolatus Hoffm.

COMMON THISTLE

Roadsides and pastures. Common. August. Introduced.

Carduus arvensis (*L.*) *Robs.*

Cnicus arvensis Hoffm.

CANADA THISTLE

Fields, pastures and roadsides. Common. July and August. A most troublesome introduced weed spreading both by seeds and deep subterranean rootstocks.

Carduus muticus (*Mx.*) *Pers.*

Cnicus muticus Pursh

AWNLESS SWAMP THISTLE

Swamps and wet places, woods and clearings. August.

Hieracium aurantiacum *L.*

ORANGE HAWKWEED. PAINT BRUSH

Meadows and pastures. Lake Placid, Wood farm and John Brown farm. An introduced and troublesome weed. It spreads by seeds and by runners, grows rapidly and crowds out other and better plants. Upon its first appearance in a meadow or pasture it should be promptly

destroyed. If it has become abundant it may be subdued by an application of salt. Putting the infested field under thorough cultivation will also overcome it to some extent.

Hieracium Canadense *Mx.*

CANADA HAWKWEED. SHARP TOOTH HAWKWEED.

Thin woods and bushy places. Rare. Raybrook. August and September.

Hieracium scabrum *Mx.*

ROUGH HAWKWEED

Dry soil in pastures and clearings. Common. August. This is the prevailing species of hawkweed in North Elba.

Hieracium Pilosella *L.*

PILOSE HAWKWEED

Found by Mrs Bodman in a dooryard at Lake Placid. It is an introduced plant and perhaps is not permanently established.

Nabalus altissimus (*L.*) *Hook.*

Prenanthes altissima L.

FALL PRENANTHES. TALL WHITE LETTUCE

Woods and open places. Common. August and September. This species and the next following one are very variable in the shape and lobing of the leaves.

Nabalus albus (*L.*) *Hook.*

Prenanthes alba L.

WHITE LETTUCE. RATTLESNAKE ROOT

Habitat and general appearance of the plant like the last. Its pappus however is darker colored and its long involucral scales are more numerous. August and September.

Nabalus trifoliatus *Cass.*

TALL RATTLESNAKE ROOT

Thin woods. Occasional. Wood farm and Indian pass. August.

Nabalus nanus (*Bigel.*) *DC.*

Prenanthes serpentaria var. *nana* Gray

LOW RATTLESNAKE ROOT

Top of Mt McIntyre. An alpine or subalpine species in which the flower heads are mostly clustered at the top of the stem and the leaves are deeply lobed or parted. Boott's rattlesnake root, *N. Boottii* DC., is found on the summit of Mt Marcy and of Mt Whiteface, but not in North Elba. Its leaves are not lobed.

Taraxacum Taraxacum (*L.*) *Karst.*

T. officinale Web.

DANDELION

Fields, pastures and waysides. Very common. May and June. Introduced and sometimes cultivated as a potherb. Young uncultivated plants are often used for the same purpose. A troublesome weed in lawns.

Lactuca Canadensis *L.*

WILD LETTUCE

Fence rows and copses. Common. August.

Lactuca spicata (*Lam.*) *Hitchc.*

L. leucophaea Gray

TALL LACTUCA. TALL BLUE LETTUCE

Similar to the preceding species in general appearance, and growing in similar places. It may be distinguished by its bluish flowers and beakless seeds.

LOBELIACEAE

Lobelia inflata *L.*

INDIAN TOBACCO

Fields, pastures and waysides. Common. August.

CAMPANULACEAE

Campanula rotundifolia *L.*

HAREBELL

Pastures, roadsides and rocky places. August. Along the road to Averyville and on the precipitous side of Wallface mountain.

Campanula aparinoides *Pursh*

MARSH BELLFLOWER

Wet or swampy ground. Occasional. Averyville swamp and along Ray brook. August. Its flowers vary from white to pale blue.

Campanula rapunculoides *L.*

RAMPION-LIKE BELLFLOWER

Introduced and still persisting about the site of a former dwelling near the upper iron bridge. August.

ERICACEAE

Vaccinium Canadense *Rich.*

CANADIAN BLUEBERRY

Thin woods, clearings and pastures, in wet or dry soil. June. This is the prevailing blueberry of North Elba. It may be known by its downy or pubescent leaves and twigs. It fruits abundantly and formerly people came long distances to pick the berries.

Vaccinium Pennsylvanicum *Lam.*

DWARF BLUEBERRY

Habitat similar to the last with which it is often associated, but it ascends to higher altitudes. The fruit of the two species is equally esteemed.

V. Pennsylvanicum angustifolium *Gray*

NARROW LEAVED DWARF BLUEBERRY

Summit of Mt McIntyre and Mt Wright. June. This variety is but a few inches high and has narrow leaves. Its small size is evidently due to its peculiar and unfavorable place of growth.

Vaccinium uliginosum *L.*

BOG BILBERRY

Indian pass and open summit of Mt McIntyre and Mt Wright. June. The fruit is black when ripe and has an agreeable acid flavor.

The swamp blueberry or high bush blueberry, *V. corymbosum* L., was not seen within the limits of the town, though it delights in cool elevated regions.

Oxycoccus macrocarpus (*Ait.*) *Pers.*

Vaccinium macrocarpon Ait.

LARGE CRANBERRY. AMERICAN CRANBERRY

Bogs and marshes. June and July. Many years ago fine specimens of this cranberry were collected at the south end of Lake Placid. It still persists there on one of the bogs.

Oxycoccus Oxycoccus (*L.*) *MacM.*

Vaccinium Oxycoccus L.

SMALL CRANBERRY

Bogs, marshes and mountain tops. Averyville swamp, Hidden swamp and the summit of Mt McIntyre and Mt Wright. June and July. This hardy little plant fruits freely in the cold bleak situations it occupies on the mountain tops. Formerly it grew in a marsh on Wood farm and was much more abundant on Hidden swamp than it is now. By the destruction of the forests and the consequent rapid evaporation of moisture the swamps gradually become drier and firmer and small shrubs become more abundant in them. Both these changes are unfavorable to the cranberry and it gradually gives up the struggle for existence.

Chiogenes hispidula (*L.*) *T. & G.*

C. serpyllifolia Salisb.

CREEPING SNOWBERRY

Not common. Indian pass and summit of Mt McIntyre. June. A pretty creeping vine with small nearly orbicular leaves of a spicy flavor and a small white edible fruit.

Gaultheria procumbens *L.*

WINTERGREEN

Heathy places. Scarce. Raybrook and Wood farm. July. The fruit persists through the winter and is larger and better in spring than in autumn. This little evergreen has many local names of which Rafinesque gives a dozen or more.

Andromeda Polifolia *L.*

WILD ROSEMARY

Bogs, marshes and banks of sluggish streams. Averyville swamp and Hidden swamp. June and July.

Camaedaphne calyculata (*L.*) *Moench*

Cassandra calyculata DC.

LEATHER LEAF

Marshes, margins of lakes and streams and tops of high mountains. Common. May and June. On the summit of Mt McIntyre this shrub is very small and flowers late and sparingly.

Kalmia angustifolia *L.*

SHEEP LAUREL. SHEEP POISON. LAMBKILL

Wet or dry soil. Common. July and August. It ascends to the top of Mt McIntyre where it blossoms in August. In some of the marshes of the Adirondacks it grows luxuriantly and has leaves longer and broader than in the common form. Its foliage is poisonous to sheep if eaten by them, as may be inferred from the common names given to the plant.

Kalmia glauca *Ait.*

PALE LAUREL. SWAMP LAUREL

Peat bogs, swamps and mountain tops. Averyville swamp, shores of Mud pond and Little Cherrypatch pond and summit of Mt McIntyre. June. The flowers of this pretty little shrub are larger and more showy than those of the preceding species. They are bright rosy red when fresh, but become purplish when old or in drying. The leaves are thick, very smooth, bright glossy green above and pale beneath.

Rhododendron Lapponicum (*L.*) *Wahl.*

LAPLAND RHODODENDRON. ALPINE ROSEBAY

Summit of Mt McIntyre and Mt Wright. June. This diminutive shrub is inconspicuous by reason of its small size, but its flowers are showy and of a beautiful purplish red color.

Ledum Groenlandicum *OEder*

L. latifolium Ait.

LABRADOR TEA

Bogs, swamps, shores and mountain tops. Common. June. In Indian pass it was found in flower in August.

Chimaphila umbellata (*L.*) *Nutt.*

PRINCE'S PINE

Woods. Rare. Raybrook and Wood farm.

Pyrola rotundifolia *L.*

ROUND LEAVED WINTERGREEN

Woods. Not rare. July.

Pyrola elliptica *Nutt.*

SHINLEAF

Woods. Common. July.

Pyrola secunda *L.*

ONE SIDED WINTERGREEN

Woods. Common. July.

P. secunda pumila *Paine*

A dwarf form differing from the type in its smaller size, fewer flowers and nearly orbicular leaves which are 6 to 9 lines in diameter. Raybrook and Moose island in Lake Placid.

Monotropa uniflora *L.*

INDIAN PIPE. CORPSE PLANT

Woods. Common. July and August. This singular waxy white plant often attracts attention by its peculiar shape and color. The single flower which terminates the stem droops or curves to one side like the bowl of a pipe, but it becomes erect with age. The whole plant turns black in drying.

Hypopitys Hypopitys (*L.*) *Small*

Monotropa Hypopitys L.

PINE SAP. FALSE BEECH DROPS

Under coniferous trees. Rare. Under young spruce trees north of North Elba post office. August.

DIAPENSIACEAE

Diapensia Lapponica *L.*

DIAPENSIA. LAPLAND DIAPENSIA

Top of Mt McIntyre and Mt Wright. A pretty little alpine plant 2 or 3 inches high, bearing a single conspicuous white flower at the top of the stem which is densely clothed below with thick but narrow often recurved evergreen leaves.

PRIMULACEAE

Lysimachia terrestris *(L.) B. S. P.*

L. stricta Ait.

RACEMED LOOSESTRIFE. BULB BEARING LOOSESTRIFE

Shores of lakes and streams, ditches and wet places. Common. July and August.

Trientalis Americana *Pursh*

STAR FLOWER. CHICKWEED WINTERGREEN

Woods and mountain tops. Common. June. It is smaller than usual when growing on the mountain tops, and generally sterile.

OLEACEAE

Fraxinus Americana *L.*

WHITE ASH

A few trees represent this species. They are on the high hill on Newman farm. This is the only known station for the species in North Elba.

Fraxinus nigra *Marsh.*

F. sambucifolia Lam.

BLACK ASH. HOOP ASH

Low wet woods and swamps. Common. May.

APOCYNACEAE

Apocynum androsaemifolium *L.*

SPREADING DOGBANE

Dry soil in open places. Scarce. July. A patch of it may be seen on the east side of Adirondack lodge road a few rods southeast of North Elba post office.

ASCLEPIADACEAE

Asclepias Syriaca *L.*

A. Cornuti Dec.

SILKWEED

Roadsides. Rare. Adirondack lodge road between the North Elba post office and Wood farm. July.

GENTIANACEAE

Gentiana linearis *Froel.*

NARROW LEAVED GENTIAN

Moist or wet places, swamps and mountain tops. Common. August. Found in nearly all parts of the Adirondacks and the only representative of the genus in North Elba.

HYDROPHYLLACEAE

Hydrophyllum Virginicum *L.*

VIRGINIA WATERLEAF

Woods. Rare. Old Keene road. June.

CONVOLVULACEAE

Convolvulus sepium *L.*

HEDGE BINDWEED

Fields and fence rows. Rare. Lake Placid and John Brown farm. August. This is sometimes a troublesome weed.

SCROPHULARIACEAE

Chelone glabra *L.*

SNAKE HEAD. SHELLFLOWER

Wet places and along streams. Common. August.

Verbascum Thapsus *L.*

MULLEIN

A common weed in pastures and by roadsides. Introduced. August.

Veronica Americana *Schw.*

AMERICAN BROOKLIME

Banks of the Ausable south of Brewster's mill. June.

Veronica arvensis *L.*

CORN SPEEDWELL

An introduced weed in cultivated ground. Lake Placid.

Veronica serpyllifolia *L.*

THYME LEAVED SPEEDWELL

Rare. Raybrook and Wood farm. July.

Melampyrum lineare *Lam.*

M. Americanum Mx.

AMERICAN COW WHEAT

Thin woods and clearings. Common. August. It ascends to the top of Mt McIntyre.

LENTIBULACEAE

Utricularia vulgaris *L.*

COMMON BLADDERWORT. GREATER BLADDERWORT

Lakes and sluggish streams. Raybrook and Lake Placid. August.

Utricularia cornuta *Mx.*

HORNED BLADDERWORT

Bogs in the south end of Lake Placid. August.

LABIATAE

Mentha arvensis *L.*

CORN MINT

Waysides. Lake Placid. August. An introduced plant which is sometimes a troublesome weed in cultivated ground.

Mentha Canadensis *L.*

CANADIAN MINT. WILD MINT

Shores and wet places. Common. August.

Lycopus Virginicus *L.*

BUGLEWEED

Wet or moist ground. Common. August.

Lycopus sinuatus *L.*

WATER HOARHOUND

Growing with the preceding species or in similar places but less abundant. Both are reputed to possess medicinal properties.

Nepeta Cataria *L.*

CATNIP

An introduced plant found chiefly in waste places about houses. Lake Placid. August.

Glechoma hederacea *L.*

Nepeta Glechoma Benth.

GROUND IVY. GILL-OVER-THE-GROUND

Waste places. Lake Placid and near the upper iron bridge. Introduced. June and July.

Scutellaria lateriflora *L.*

MAD DOG SKULLCAP

Shores and wet places. Common. August. The common name commemorates its formerly supposed efficacy in preventing hydrophobia. It now has some reputation as a nervine.

Scutellaria galericulata *L.*

COMMON SKULLCAP

Shores and wet places. Common. August.

Prunella vulgaris *L.*

Brunella vulgaris L.

SELF HEAL. HEAL ALL

Fields, pastures and roadsides. Common. July and August.

Galeopsis Tetrahit *L.*

HEMP NETTLE

Waste grounds, commonly about houses and barns. August. An introduced weed. A form having white flowers sometimes occurs. A thrifty patch of this plant was found on the top of Ampersand mountain.

Stachys palustris *L.*

MARSH HEDGE NETTLE

Marshes and wet ground, but sometimes on dry upland. Rare. Allen farm. Probably a recent introduction.

PLANTAGINACEAE

Plantago major *L.*

COMMON PLANTAIN

Pastures and roadsides. Very common. An introduced plant nearly always to be found about houses, and even in the gutters of the less frequented streets of cities and villages. In the Adirondacks a small form occurs in sandy or gravelly soil along the shores of lakes and streams.

Plantago Rugelii *Dec.*

RUGEL'S PLANTAIN

Habitat the same as in the preceding species but less common. Allen farm. August.

AMARANTHACEAE

Amaranthus retroflexus *L.*

ROUGH PIGWEED

Cultivated ground and gardens. Common. August. Introduced.

CHENOPODIACEAE

Chenopodium album viride (*L.*) *Moq.*

GOOSEFOOT. LAMB'S QUARTERS. PIGWEED

Cultivated fields and gardens. Common. August. Introduced. This and the preceding are troublesome weeds. The broad leaved typical form of the species, *C. album* L., is apparently absent from North Elba.

POLYGONACEAE

Fagopyrum Fagopyrum (*L.*) *Karst.*

F. esculentum Moench

BUCKWHEAT

Introduced and cultivated for its seeds. It is often found growing spontaneously in old fields and by roadsides. July and August.

Fagopyrum Tataricum (*L.*) *Gaert.*

TARTARY WHEAT. INDIA WHEAT

The remarks under the preceding species are applicable to this also.

POLYGONUM

	Leaves ovate	1
	Leaves oblong or lanceolate	2
1	Stem ciliate at the nodes, flowers in racemes	cilinode
1	Stem not ciliate at the nodes, flowers not racemed	Convolvulus
2	Stem armed with recurved prickles	sagittatum
2	Stem unarmed	3
3	Flowers inconspicuous, in the axils of the leaves	aviculare
3	Flowers in slender drooping racemes	Hydropiper
3	Flowers in erect spike-like racemes	4
4	Peduncles glandular	Pennsylvanicum
4	Peduncles glabrous	Persicaria

Polygonum cilinode *Mx.*

FRINGE JOINT POLYGONUM

Rocky places and along fences. Common. July and August.

P. cilinode brevis *n. var.*

Stems about a foot long, erect, flowers terminal or nearly so. Top of Cobble hill. August and September. This variety seems to be peculiar to the Adirondack region. It was found several years ago on the summit of Bald mountain on the west shore of Third lake.

Polygonum Convolvulus *L.*

BLACK BINDWEED

Cultivated ground. Raybrook. August. Introduced and a troublesome weed in gardens.

Polygonum sagittatum *L.*

ARROWHEAD. TEARTHUMB

Wet ground, swales and ditches. Common. August.

Polygonum aviculare *L.*

KNOTGRASS. DOORWEED

Hard compact soil. About dwellings, by roadsides and pathways. Common. The erect knotweed, *P. erectum* L., is often associated with this species but no representatives of it were seen in North Elba.

Polygonum Hydropiper *L.*

SMARTWEED. WATER PEPPER

Ditches and wet places. Common. August.

Polygonum Pennsylvanicum *L.*

HAIRY STALK PERSICARIA. PENNSYLVANIA PERSICARIA

Gardens and cultivated fields. Rare. Lake Placid. August.

Polygonum Persicaria *L.*

LADY'S THUMB

Gardens and fields. Common. August. Introduced.

Rumex crispus *L.*

CURLED DOCK

Fields, gardens and waste places. Common. July. Introduced.

Rumex obtusifolius *L.*

BITTER DOCK. BROAD LEAVED DOCK

Roadsides and waste places. Occasional. Lake Placid and near North Elba post office.

Rumex Acetosella *L.*

SHEEP SORREL FIELD SORREL

Fields, pastures and waysides. Abundant. A very pernicious weed. This and the preceding species are introduced plants

THYMELEACEAE

Dirca palustris *L.*

LEATHERWOOD. MOOSEWOOD

Damp soil. Rare. Wood's sap works. May. Remarkable for the toughness of its bark and twigs.

LORANTHACEAE

Razoumofskya pusilla (*Pk.*) *Kuntze*

Arceuthobium pusillum Pk.

DWARF ARCEUTHOBIUM

Parasitic on living branches of spruce trees. Averyville swamp. September.

EUPHORBIACEAE

Euphorbia Cyparissias *L.*

CYPRESS SPURGE

Roadside at the cemetery from which it is spreading. Introduced.

URTICACEAE

Urtica dioica *L.*

Stinging nettle

Roadsides and waste places. Raybrook. August

Urtica gracilis *Ait.*

Slender nettle

Roadsides. Lake Placid and Wood farm. August

Urticastrum divaricatum (*L.*) *Kuntze*

Laportea Canadensis Gaud.

Wood nettle

Wet or moist places in woods. Common. July and August. Notwithstanding its stinging prickles the foliage of this plant is apparently sometimes eaten by deer.

Ulmus Americana *L.*

American elm. White elm

Valley of the Ausable and Newman farm. Scarce. May.

MYRICACEAE

Myrica Gale *L.*

Sweet gale

Swamps and shores of lakes. Mirror lake. May.

Comptonia peregrina (*L.*) *Coulter*

Myrica asplenifolia Endl.

Sweet fern

Dry, sandy or rocky soil. Near the cemetery. June.

CUPULIFERAE

Alnus incana (*L.*) *Willd.*

Speckled alder. Hoary alder

Swamps and shores of lakes and streams. Common. May.

Alnus Alnobetula (*Ehrh.*) *Koch*

A. viridis DC.

GREEN ALDER. MOUNTAIN ALDER

Summit of Mt McIntyre and Mt Wright. May and June.

Betula lutea *Mx*

YELLOW BIRCH. GRAY BIRCH

Very common. One of the principal forest trees of the region. May.

Betula papyrifera *Marsh.*

WHITE BIRCH. PAPER BIRCH. CANOE BIRCH

Scattered through the forests but not plentiful. It sometimes attains a large size. May.

B. papyrifera minor *Tuckm.*

Open summit of Mt McIntyre and in Indian pass. A low straggling shrub or small tree with a brown or reddish brown bark with no traces of the usual white color of the species. Along the trail on the west side of Mt Wright several trees of this species were seen the bark of whose trunks was blackish brown although they had a basal diameter of 3 or 4 inches. The color of the bark was similar to that of the cherry birch, *B. lenta* L.

Corylus rostrata *Ait.*

BEAKED HAZELNUT

Waysides and clearings. Common. May. It is sometimes erroneously called witch hazel. The witch hazel was not seen in North Elba, but it occurs in the adjoining town of Keene.

Fagus Americana *Sweet*

F. ferruginea Ait.

BEECH. AMERICAN BEECH

Very common. May and June. In many places this tree is more plentiful than either the yellow birch or the sugar maple. These three trees constitute the greater part of the deciduous trees of the forests.

Ostrya Virginiana (*Mill.*) *Willd.*

O. Virginica Willd.

HOP HORNBEAM. IRONWOOD

Scarce. Placid club grounds and Ausable valley. May and June. The blue beech, *Carpinus Caroliniana* Walt., occurs in some parts of the Adirondacks and even in the adjoining town of Keene, but it was not seen in North Elba.

SALICACEAE

SALIX

Stamens five	lucida
Stamens two	1
1 Capsules glabrous	2
1 Capsules pubescent or silky	4
2 Dwarf, prostrate or spreading alpine shrub	Uva-ursi
2 Erect shrubs, not alpine	3
3 Leaves lanceolate	cordata
3 Leaves elliptic or ovate	balsamifera
4 Leaves tomentose beneath	Bebbiana
4 Leaves silky beneath	sericea
4 Leaves glaucous beneath	discolor

Salix lucida *Muhl.*

SHINING WILLOW. GLOSSY WILLOW

Margins of streams and lakes. Common. June. Two forms occur in one of which the leaves are 12 to 18 lines wide, in the other, 6 to 10.

Salix Uva-ursi *Pursh*

BEARBERRY WILLOW

Summit of Mt McIntyre and Mt Wright. June.

Salix cordata *Muhl.*

HEART LEAVED WILLOW

Margins of streams and lakes. Scarce. Round lake. May and June.

Salix balsamifera (*Hook.*) *Barratt*

BALSAM WILLOW

Near the southeast shore of Mirror lake and near the south end of Lake Placid. May. The margin of the leaves and the lower surface do not agree rigidly with the description of the balsam willow leaves, but in other respects the characters of the species are well shown.

Salix Bebbiana *Sarg.*

S. rostrata Richardson

BEBB'S WILLOW. BEAKED WILLOW

This is the prevailing willow in North Elba and in many other parts of the Adirondacks. It is very variable in its foliage and general appearance and not very particular as to its habitat. It grows in wet or

in dry soil and its leaves may have a grayish green or a purplish brown hue, specially when young.

Salix sericea *Marsh.*

SILKY WILLOW

Along the Ausable. May.

Salix discolor *Muhl.*

GLAUCOUS WILLOW. PUSSY WILLOW

Along streams and in wet places. Common. May.

S. discolor prinoides (*Pursh*) *Anders.*

Near the Notch house and by the side of the road to Epps farm. Distinguished by its small narrow leaves.

Populus tremuloides *Mx.*

ASPEN. AMERICAN ASPEN

Light sandy or gravelly soil. Common. April and May. On the tract known as the Alger job, through which the road to Adirondack lodge passes, there are several trees of this species whose bark is scarcely less white than that of the paper birch.

Populus grandidentata *Mx.*

LARGE TOOTHED ASPEN

Less plentiful than the preceding species. Lake Placid. April and May. The young leaves are covered with a whitish silky tomentum. This makes the tree conspicuous and is a good mark of distinction between this and the preceding species while the tomentum remains on the leaves.

Populus balsamifera *L.*

BALM-OF-GILEAD. BALSAM POPLAR. TACAMAHAC

In a ravine east of the cemetery. April and May.

P. balsamifera candicans (*Ait.*) *Gray*

Near Mountain View house.

EMPETRACEAE

Empetrum nigrum *L.*

BLACK CROWBERRY

Indian pass and top of Mt McIntyre and Mt Wright. A pretty little heath-like undershrub.

CONIFERAE

Pinus Strobus *L.*

WHITE PINE. WEYMOUTH PINE

The largest, most noble and most valuable of the forest trees of the Adirondacks. Of it not many full grown representatives remain. A few trees of the old stock or virgin forest are still standing on the land of the Placid club and a few at the south end of Lake Placid. The largest tree seen by me in the town is on Wood farm, on the east bank of the Ausable. It has a basal circumference of 15 feet. These old pine trees lift their heads above the other trees of the forest and spread their branches and foliage in the unobstructed sunlight. But on account of their commercial value, they are generally the first to be taken by the lumbermen if they are in the vicinity of a stream down which the logs can be floated to mill or to market. The species is easily recognized by its long cylindric cones with their unarmed scales and by its slender leaves which grow in fascicles or clusters of fives.

Pinus resinosa *Ait.*

RED PINE. CANADIAN PINE. NORWAY PINE

This tree occurs in the western part of the town, but is absent from the eastern part. Young trees are common about Raybrook and an occasional tree is seen in the vicinity of Lake Placid, but none east of the Ausable. Its cones are ovate and have thick but unarmed scales and its leaves are long, coarse and two in a cluster. The pitch pine, *Pinus rigida* Mill., is absent.

Picea Canadensis (*Mill.*) *B. S. P.*

P. alba Lk.

WHITE SPRUCE

Young trees of this spruce are not rare in and near the valley of the Ausable. They are in and about Newman, near the cemetery, south of Brewster's mill and east and southeast of Mountain View house. In the last locality are a few trees of large size. In the low woods between Wood farm and Freemans Home an occasional tree occurs with naked trunk of suitable size for lumber. This spruce is readily distinguished from our other species by its longer slender leaves which are generally of a silvery or glaucous green hue, and by its pale glabrous twigs. Its

young shoots and leaves develop earlier in the season than those of the other species, its young twigs being 2 to 4 inches long when the terminal buds of the others are just beginning to burst and reveal their contents. A dwarf form occurs on the top of Mt McIntyre, in which the leaves are shorter and more slender than in the common form and are without the glaucous hue. It bears no cones and is referred to this species because its twigs are glabrous.

Picea Mariana *(Mill.) B. S. P.*

P. nigra Lk. *P. nigra* var. *rubra* Engelm.

BLACK SPRUCE

Considerable confusion and difference of opinion have resulted from recent efforts to identify the red spruce of Lambert and separate it from the black spruce of early writers. The *Manual*, accepting Dr Engelmann's view, admitted it in the last edition as a variety of the black spruce, and this is in harmony with the view of that most excellent botanist and dendrologist, Michaux. In *Illustrated flora* it is admitted as a distinct species, but I have failed to find any spruce in the Adirondacks that shows well the characters therein ascribed to it. The upland form with dark green foliage and larger cones, which in the *Manual* is taken to be a variety of the black spruce, has recently been published by Prof. Sargent as a distinct species to which he has given the name *Picea rubens*. This is understood by him to be the same as Lambert's red spruce, *P. rubra*. We have followed the *Manual* in classing it with the black spruce.

Picea brevifolia *Pk.*

SWAMP SPRUCE

Peat bogs and marshes. Averyville swamp, Hidden swamp and Wood farm swamp. This is taken by Prof. Sargent in *Silva of North America* to be a small form of the black spruce, *P. Mariana*. It differs in some respects from the characters ascribed by him to the black spruce and it seems best to keep it distinct.

P. brevifolia semiprostrata *Pk.*

A small sterile half prostrate form found on the open summit of Mt McIntyre and Mt Wright. All the spruces of North Elba blossom in June.

Tsuga Canadensis *Carr.*

HEMLOCK. HEMLOCK SPRUCE

Woods south of John Brown farm and sparingly along Indian pass trail. This species is abundant in some parts of the Adirondack region, and its scarcity in North Elba is one of the peculiarities of its flora.

Abies balsamea (*L.*) *Mill.*

BALSAM FIR. BALSAM

A small tree. Very common but very beautiful and symmetrical when well grown, but very irregular and straggling when growing in rocky, bleak and exposed places on high mountains. In North Elba it grows both in lowland and upland, in marshes and on mountains, in woods and in pastures and open places. Its foliage usually has a silvery luster but this is not constant. Its leaves sometimes spread laterally along the sides of the branches, in other instances they project in all directions except downward, in this respect imitating the leaves of spruces. They are blunt or notched. The cones are produced on short branches near the top of the tree. They stand erect and when mature their scales fall from the axis, leaving it attached to the branch. The flowers appear early in June. The bark contains numerous reservoirs or blisters which contain a limpid viscid resin or pitch known as Canada balsam. The smooth bark, the shape and mode of attachment of the leaves and the length and position of the cones all furnish available characters for distinguishing the balsam fir from the spruces. An unusually large tree of this species is standing on the land of the Placid club.

Larix laricina (*Du Roi*) *Koch*

L. Americana Mx.

TAMARACK. AMERICAN LARCH

Swamps, marshes and upland. Common. Our only conifer having deciduous leaves. A few years ago an introduced insect attacked the tamarack trees, and feeding upon the leaves in such numbers as to defoliate the trees, it destroyed many of them, for the tree could not long survive the frequent loss of all its leaves. The insect seems to be less abundant now and the trees still living are regaining their former thrifty appearance.

Thuja occidentalis *L.*

ARBOR VITAE. WHITE CEDAR.

Shores of lakes, along streams and sometimes far up on the sides of mountains. A small shrubby form occurs on the open summit of Mt Wright. It was not seen on Mt McIntyre.

Juniperus nana *Willd.*

J. communis L. (in part)

LOW JUNIPER

In a pasture near Mountain View house. This is its only known station in North Elba and but a single representative of the species was found there. The alpine variety, *J. communis* var. *alpina* Gaud. of the *Manual*, however, occurs on the top of Mt McIntyre and Mt Wright where it seeks the shelter of rocks and scarcely rises above the mosses and lichens among which it grows. It is nearly prostrate in its mode of growth and its leaves are shorter than in the common form. It was not found in fertile condition.

Taxus minor (*Mx.*) *Britton*

T. Canadensis Willd.

GROUND HEMLOCK. AMERICAN YEW

Woods and shaded places. Along the Ausable river and the old Keene road. May and June. Its ripe fruit is red and drupe-like with a cavity in the apex in which the tip of the hard bony seed may be seen.

ORCHIDACEAE

Peramium tessellatum (*Lodd.*)

Goodyera Menziesii Lindl. (in part)

TESSELLATED RATTLESNAKE PLANTAIN

Woods. Occasional. August. M. L. Fernald has recently indicated in Rhodora the distinctive characters which separate this species from *G. Menziesii* Lindl with which it has sometimes been confused.

Peramium repens (*L.*) *Salisb.*

Goodyera repens R. Br.

SMALLER RATTLESNAKE PLANTAIN

Woods. Occasional. July and August. This plant is easily recognized by its secund flower spikes and by the peculiar white reticulations of the leaves. This form has recently been separated by M. L. Fernald as a variety to which he gives the name *ophioides*, in allusion to the marking of the leaves, the typical form lacking the white reticulations.

Corallorhiza multiflora *Nutt.*

LARGE CORALROOT

Woods. Rare. Lake Placid. July.

Corallorhiza Corallorhiza (*L.*) *Karst.*

C. innata R. Br.

EARLY CORALROOT

Woods. Old Keene road. June. A rare species of much smaller size than the preceding and flowering earlier.

Gyrostachys Romanzoffiana (*Cham.*) *MacM.*

Spiranthes Romanzoffiana Cham.

HOODED LADIES TRESSES

Roadside ditches and wet places. Common. August.

Gyrostachys gracilis (*Bigel.*) *Kuntze*

Spiranthes gracilis Beck

SLENDER LADIES TRESSES

Roadsides and pastures. Raybrook. August.

HABENARIA

	Flowers purple	psycodes
	Flowers white	dilatata
	Flowers greenish	1
1	Leaf single, obtuse	obtusata
1	Leaves two, orbicular, basal	orbiculata
1	Leaves several, cauline	bracteata

Habenaria psycodes (*L.*) *Gray*

PURPLE SWAMP ORCHIS. SMALL PURPLE FRINGED ORCHIS

Bogs, swales and swamps. Rare. Near Connery pond. August.

Habenaria dilatata (*Pursh*) *Hook.*

TALL WHITE BOG ORCHIS

Bogs and wet places. Rare. Valley of the Ausable. July. Collected here many years ago but not recently observed.

Habenaria obtusata (*Pursh*) *Richards.*

OBTUSE LEAVED ORCHIS. SMALL NORTHERN BOG ORCHIS

Wet mossy ground and bogs. Rare. Along the trail between Mt Wright and Mt McIntyre. August.

Habenaria orbiculata (*Pursh*) *Torrey*

LARGE ROUND LEAVED ORCHIS

Damp woods. Scarce. Near the road to Epps farm and on the western slope of Mt Wright. July and August. The species is easily recognized by the two large round basal leaves which lie flat on the ground. They are thick, pale green and shining and retain their moisture and vitality a long time. They are said to have been used in former times as a poultice to allay inflammation in wounds and bruises.

Habenaria bracteata (*Willd.*) *R. Br.*

LONG BRACTED ORCHIS. GREEN FLOWERED ORCHIS

Woods. Occasional. Along the old Keene road. July and August. *H. hyperborea* (L.) R. Br., *H. clavellata* (Mx.) Spreng. and *H. blephariglottis* (Willd) Torrey may be expected to occur.

Cypripedium acaule *Ait.*

STEMLESS LADIES SLIPPER. PURPLE LADIES SLIPPER. MOCCASIN FLOWER

Damp woods, specially under coniferous trees. Common. June and July.

Listera cordata (L.) R. Br., was collected many years ago on the southern slope of Mt Whiteface not far beyond the town line.

IRIDACEAE

Iris versicolor *L.*

LARGER BLUE FLAG

Swamps and shores. Common. June The root is medicinal. The flowers are beautiful.

Sisyrinchium angustifolium *Mill.*

POINTED BLUE EYED GRASS

Meadows and pastures. Common. June.

LILIACEAE

Polygonatum biflorum (*Walt.*) *Ell.*

SMALLER SOLOMON'S SEAL. HAIRY SOLOMON'S SEAL

Woods. Rare. Adirondack lodge road. June.

Vagnera racemosa (*L.*) *Morong*

Smilacina racemosa Desf.

FALSE SPIKENARD. WILD SPIKENARD

Bushy places and clearings. Common. June.

Vagnera trifolia *(L.) Morong*

Smilacina trifolia Desf.

THREE LEAVED SOLOMON'S SEAL

Bogs and swamps. Rare. Averyville swamp and Wood farm swamp. June.

Unifolium Canadense *(Desf.) Greene*

Maianthemum Canadense Desf.

TWO LEAVED SOLOMON'S SEAL. FALSE LILY-OF-THE-VALLEY

Woods, swamps, pastures and mountain tops. Common. June. Abundant on the top of Mt McIntyre.

Streptopus roseus *Mx.*

ROSE FLOWERED TWIST FOOT. SESSILE LEAVED TWISTED STALK

Woods and mountains. Common. June.

Streptopus amplexifolius *(L.) DC.*

CLASPING LEAVED TWISTED STALK

Woods and mountain slopes. Occasional. Base of Pitchoff mountain, head of Cascade lake and trail to Mt McIntyre. June. Less frequent than the preceding species, from which it may be distinguished by its greenish white flowers and the naked margins of its leaves. Both species sometimes have the peduncle forked. The ripe fruit is red.

Clintonia borealis *(Ait.) Raf.*

NORTHERN CLINTONIA. YELLOW CLINTONIA

Woods, swamps and open places. Very common. June and July. This plant is found almost everywhere in the Adirondack region. It ascends to the top of the highest mountains. In these elevated places it may be found in flowers at the time the plants in the valleys are bearing ripe fruit. The ripe fruit is deep blue and almost as attractive as the flowers. Vigorous plants often have a lateral cluster of flowers an inch or two below the terminal cluster, and in rare instances there are two lateral clusters. The number of flowers in a lateral cluster is less than in the terminal cluster.

Uvularia sessilifolia *L.*

Oakesia sessilifolia Wats.

SESSILE LEAVED BELLWORT

Thin woods and open places. Common. June.

Erythronium Americanum *Ker.*

YELLOW ADDER'S TONGUE

Woods and pastures. Common. May.

Medeola Virginiana *L.*

INDIAN CUCUMBER ROOT

Woods. Common. June. The fleshy white root is suggestive of the common name, its shape and flavor bearing some resemblance to the shape and flavor of a cucumber.

Trillium erectum *L.*

FALSE WAKE ROBIN. ILL SCENTED WAKE ROBIN

Woods and thickets. Common. May and June.

Trillium undulatum *Willd.*

T. erythrocarpum Mx.

PAINTED WAKE ROBIN

Woods and clearings, specially in soil abounding in vegetable mold. Common. June. The white petals are beautifully striped with purple lines.

Veratrum viride *Ait.*

AMERICAN WHITE HELLEBORE. INDIAN POKE

Swamps and wet places, also on the tops of high mountains. Common. June. The dried powdered leaves are reputed to be a good substitute for the white hellebore of commerce.

JUNCACEAE

JUNCUS

	Stems naked, scape-like	1
	Stems leafy	2
1	Stamens three	effusus
1	Stamens six	filiformis
2	Leaves with transverse septa	Canadensis
2	Leaves without transverse septa	3
3	Stems less than 6 inches long	bufonius
3	Stems more than 6 inches long	tenuis

Juncus effusus *L.*

BOG RUSH. SOFT RUSH

Ditches and wet places. Common.

Juncus filiformis *L.*

THREAD RUSH

Wet places. Rare. Shore of Marsh pond and on Newman farm.

Juncus Canadensis *J. Gay*

J. Canadensis longicaudatus Engelm.

CANADA RUSH

Wet places. Lake Placid. August.

J. Canadensis brevicaudatus *Engelm.*

J. Canadensis var. *coarctatus* Engelm.

NARROW PANICLED RUSH

Ditches, wet places and road sides. Very common.

Juncus bufonius *L.*

TOAD RUSH

Hard ground by roadsides. Common.

Juncus tenuis *Willd.*

SLENDER RUSH. YARD RUSH

Pastures and waysides in soil wet or dry. Common and variable.

Juncoides campestre (*L.*) *Kuntze*

Luzula campestris DC.

WOOD RUSH

Dry soil in pastures and clearings. Common. May and June.

Juncoides pilosum (*L.*) *Kuntze*

Luzula vernalis DC.

HAIRY WOOD RUSH

Woods and bushy places. Common. May.

Juncoides parviflorum (*Ehrh.*) *Coville*

Luzula spadicea var. *melanocarpa* Meyer

Wet places and mountain sides. Occasional. Road to Epps farm, Notch road and trail to Mt McIntyre.

Juncoides spicatum (*L.*) *Kuntze*

Luzula spicata Desv.

SPIKED WOOD RUSH

Top of Mt Wallface. This is its only known station in our state. Found there in June 1898.

TYPHACEAE

Typha latifolia *L.*

BROAD LEAVED CAT TAIL

Bogs and muddy shores. Common. July.

Sparganium simplex *Huds.*

SIMPLE STEMMED BUR REED

Along streams and margins of lakes. Ausable river. July and August.

Sparganium androcladum fluctuans *Morong*

S. simplex fluitans Engelm.

Shallow water. Lake Placid. August. The long narrow leaves float on the surface of the water.

ARACEAE

Arisaema triphyllum (*L*) *Torrey*

INDIAN TURNIP. JACK-IN-THE-PULPIT

Moist soil in woods and open places. Common. May and June.

Calla palustris *L.*

WATER ARUM. WILD CALLA

Swamps, bogs and water holes. Little Cherrypatch pond. July.

ALISMACEAE

Sagittaria latifolia *Willd.*

S. variabilis Engelm.

BROAD LEAVED ARROWHEAD

Shallow water and wet places. Lake Placid, Mirror lake and John Brown farm. July and August. The leaves in this species are very variable in the width of the blades and the lobes. Several forms recognized in the *Manual* as varieties occur in Lake Placid and Mirror lake. The obtuse leaf form, var. *obtusa*, the diverse leaf form, var. *diversifolia*, and the narrow leaf form, var. *angustifolia* may be found.

NAIADACEAE

POTAMOGETON

	Leaves of two kinds, submerged and floating	1
	Leaves all submerged	4
1	Submerged leaves filiform, bladeless	2
1	Submerged leaves not bladeless	3
2	Floating leaves an inch broad or more	natans
2	Floating leaves less than an inch broad	Oakesianus
3	Submerged leaves linear, sessile, two ranked	Nuttallii
3	Submerged leaves linear-lanceolate, tapering to a sessile base	alpinus
3	Submerged leaves broad, petiolate	amplifolius
4	Leaves ovate or lanceolate, less than 3 in. long	perfoliatus
3	Leaves elongated, more than 3 in. long	praelongus

Potamogeton natans *L.*

FLOATING PONDWEED

Shallow water. South end of Lake Placid.

Potamogeton Oakesianus *Robbins*

OAKES'S PONDWEED

Shallow water. Mirror lake. Fruiting specimens not seen.

Potamogeton Nuttallii *C. & S.*

P. Pennsylvanicus Cham.

NUTTALL'S PONDWEED

A common species in some parts of the Adirondacks but rare in North Elba. Lake Placid.

Potamogeton alpinus *Babbis*

P. rufescens Schrad.

NORTHERN PONDWEED

South end of Cascade lake. July. This and the next species just come within the town limits at this place. They were collected here many years ago, but have not been noticed elsewhere.

Potamogeton amplifolius *Tuckm.*

LARGE LEAVED PONDWEED

South end of Cascade lake. July.

Potamogeton perfoliatus *L.*

CLASPING LEAVED PONDWEED

Ausable river near the Notch house. July.

Potamogeton praelongus *Wulf.*

LONG STEMMED PONDWEED. WHITE STEMMED PONDWEED

Lake Placid. July. It was found growing in water 6 to 10 feet deep.

ERIOCAULEAE

Eriocaulon septangulare *With.*

SEVEN ANGLED PIPEWORT

Shallow water and shores of lakes and streams. Lake Placid and Mirror lake. July and August. The scapes vary from 2 inches to 2 feet in length. When growing in water their length depends on the depth of the water.

CYPERACEAE

Dulichium arundinaceum (*L.*) *Britton*

D. spathaceum Pers.

DULICHIUM

Wet places, shores and shallow water. Common. July and August.

Eleocharis palustris (*L.*) *R. & S.*

SPIKE RUSH. CREEPING SPIKE RUSH

Wet places and shallow water. Lake Placid, Mirror lake and Newman farm. August.

Eleocharis ovata (*Roth*) *R. & S.*

OVOID SPIKE RUSH

Wet places. John Brown farm. July and August.

Scirpus caespitosus *L.*

TUFTED CLUB RUSH

Top of Mt McIntyre and Mt Wright and in a marshy place west of Mt Wallface. In flower in June, in fruit in July and August.

Scirpus atrovirens *Muhl.*

DARK GREEN BULRUSH

Moist ground and wet places. Common. July.

Scirpus microcarpus *Presl.*

S. sylvaticus var. *digynus* Boeckl.

SMALL FRUITED BULRUSH

Wet places along Adirondack lodge road. August.

Scirpus cyperinus (*L.*) *Kunth*

Eriophorum cyperinum L.

WOOL GRASS

Swamps and wet places. Very common. August.

Two varieties of this species occur in some parts of the Adirondack region. One is *S. cyperinus Eriophorum* (Mx.) Britton, which is *Eriophorum cyperinum* var. *laxum* W. & C. of the *Manual*; the other is *S. cyperinus condensatus* Pk.

Eriophorum vaginatum *L.*

SHEATHED COTTON GRASS

Swamps and mountain tops. June and July. North end of Mirror lake, Averyville swamp, Wood farm swamp and summit of Mt McIntyre.

Eriophorum Virginicum *L.*

VIRGINIA COTTON GRASS

Bogs, swamps and wet places. Common. August.

CAREX

	Inflorescence monoecious	1
	Inflorescence dioecious	scirpoidea
1	Staminate flowers forming one or more separate terminal spikes	2
1	Staminate flowers not forming separate spikes	28
2	Pistillate spikes sessile or the lowest on a short inconspicuous or included peduncle, erect or spreading	3
2	Pistillate spikes on distinct or exserted peduncles, often recurved or drooping	17
3	Pistillate spikes globose or ovoid	4
3	Pistillate spikes oblong or cylindric	8
4	Perigynia pubescent	5
4	Perigynia glabrous	7
5	Leaves 1.5-2 lines wide	pedicellata
5	Leaves 1 line wide or less	6
6	Staminate spike 3 lines long or more	Novae-Angliae
6	Staminate spike less than 3 lines long	deflexa
7	Perigynia 5 lines long or more	intumescens

7 Perigynia less than 5 lines long	oligosperma
8 Pistillate spikes 2.5 lines wide or more	9
8 Pistillate spikes 1–2 lines wide	14
9 Perigynia pubescent	10
9 Perigynia glabrous	11
10 Leaves 2 lines wide or more	Houghtonii
10 Leaves less than 2 lines wide	filiformis
11 Staminate spike one	12
11 Staminate spikes more than one	13
12 Pistillate spikes 5–6 lines wide	lurida
12 Pistillate spikes 3–4 lines wide	Baileyi
13 Pistillate spikes 4–5 lines wide	utriculata
13 Pistillate spikes 3–4 lines wide	monile
14 Plant alpine, scales as broad as the perigynia	Bigelovii
14 Plant not alpine, scales narrower than the perigynia	15
15 Scales spreading, acute, longer than the perigynia	Haydeni
15 Scales erect or appressed, commonly obtuse	16
16 Pistillate spikes approximate, basal sheaths not fibrillose	lenticularis
16 Pistillate spikes distant, basal sheaths fibrillose	stricta
17 Pistillate spikes erect or spreading or the lowest sometimes drooping	18
17 Pistillate spikes recurved or drooping	22
18 Pistillate spikes densely flowered	19
18 Pistillate spikes loosely flowered	20
19 Perigynia scabrously pubescent, beaked	scabrata
19 Perigynia glabrous, with a twisted beak	torta
19 Perigynia glabrous, beakless	pallescens
20 Sheaths of the bracts purple	plantaginea
20 Sheaths of the bracts green	21
21 Perigynia faintly nerved, beak straight, scales purplish	altocaulis
21 Perigynia distinctly nerved, beak bent, scales pale	laxiflora
22 Pistillate spikes less than 6 lines long	23
22 Pistillate spikes more than 6 lines long	24
23 Radical spikes present	pedunculata
23 Plant with no radical spikes	Magellanica
24 Pistillate spikes 2–3 lines wide	25
24 Pistillate spikes less than 2 lines wide	26
25 Perigynia round-obovate	crinita
25 Perigynia oblong-ovate	gynandra
26 Scales purplish brown or blackish	torta
26 Scales pale or green	27
27 Perigynia oblong, beakless	gracillima
27 Perigynia oblong, beaked, short stalked	arctata
27 Perigynia fusiform, beaked, sessile	tenuis
28 Spike single, staminate above	29
28 Spikes more than one	30
29 Perigynia subulate-pointed	pauciflora

29 Perigynia obtuse		polytrichoides
	30 Staminate flowers terminal	31
	30 Staminate flowers basal	33
31 Leaves less than 1 line wide		tenella
31 Leaves more than 1 line wide		32
	32 Perigynia about 2 lines long	stipata
	32 Perigynia scarcely 1 line long	vulpinoidea
33 Perigynia 2 lines long or more		34
33 Perigynia less than 2 lines long		36
	34 Perigynia winged on the margin	35
	34 Perigynia not winged on the margin	Deweyana
35 Spikes obtuse		tribuloides
35 Spikes acute		scoparia
	36 Perigynia long-beaked, horizontal or reflexed	sterilis
	36 Perigynia short-beaked, not reflexed	37
37 Spikes 2–3, distant		trisperma
37 Spikes more than 3, the upper crowded or approximate		38
	38 Spikes many flowered, silvery green	canescens
	38 Spikes few flowered, green or brownish	brunnescens

Carex oligosperma *Mx.*

FEW SEEDED SEDGE

Averyville swamp. August.

Carex intumescens *Rudge*

BLADDER SEDGE

Swamps, wet places and dry ground. Very common. July and August.

Carex utriculata *Boott*

BOTTLE SEDGE

Shores and wet places. John Brown farm. July and August.

Carex monile *Tuckm.*

NECKLACE SEDGE

Shores and wet places. John Brown farm, Round lake and Marsh pond. August.

Carex lurida *Wahl.*

SALLOW SEDGE

Along streams and ditches by roadsides. Very common. August.

Carex Baileyi *Britton*

C. lurida var. *gracilis* Bailey

BAILEY'S SEDGE

Wet places. Common. This is distinguished from the preceding species by its more slender habit and more narrow spikes of which there are rarely more than two.

Carex scabrata *Schw.*

ROUGH SEDGE

Wet places. Occasional. Near north entrance to Indian pass. July.

Carex Houghtonii *Torrey*

HOUGHTON'S SEDGE

Many years ago I collected specimens of this sedge near the present site of the Stevens house. I have not seen it in my recent visits to Lake Placid.

Carex filiformis *L.*

SLENDER SEDGE

Swamps and marshes. Averyville swamp. July and August.

Carex stricta *Lam.*

TUSSOCK SEDGE

Swamps, shores and wet places. Common. June.

Carex Haydeni *Dewey*

C. stricta var. *decora* Bailey

HAYDEN'S SEDGE

Wet places. Ausable valley and South Meadow. July.

Carex lenticularis *Mx.*

LENTICULAR SEDGE

Gravelly shores of lakes and streams. Clear lake, Round lake and Lake Placid. June.

Carex Bigelovii *Torrey*

C. vulgaris var. *hyperborea* Boott.

BIGELOW'S SEDGE

Top of Mt McIntyre. July and August. In the Adirondacks this sedge is limited in its habitat to the mountain tops.

Carex torta *Boott*

TWISTED SEDGE

Shores of lakes and streams. Mirror lake. June and July.

Carex crinita *Lam.*

FRINGED SEDGE

Wet or moist soil. Very common. June and July.

Carex gynandra *Schw.*

NODDING SEDGE

Wood farm swamp. June. In the *Manual* this sedge is united with the fringed sedge, both being regarded as forms of one species.

Carex Magellanica *Lam.*

MAGELLAN SEDGE

Bogs and swamps. Averyville swamp. June. The mud sedge, *C. limosa* L., is often associated with this species but I have not seen it in North Elba.

Carex arctata *Boott*

DROOPING WOOD SEDGE

Woods, clearings and meadows. Common. June and July.

C. arctata Faxoni *Bailey*

A large form of this variety occurs near Little Cherrypatch pond.

Carex tenuis *Rudge*

C. debilis var. *Rudgei* Bailey

SLENDER STALKED SEDGE

Woods and pastures. Averyville and trail to Mt McIntyre. August.

Carex gracillima *Schw.*

GRACEFUL SEDGE

Woods and clearings. Common. June and July.

Carex pallescens *L.*

PALE SEDGE

Meadows, pastures and roadsides. June. This is one of the most abundant sedges of the town. It varies greatly in size.

Carex laxiflora *Lam.*

LOOSE FLOWERED SEDGE

Borders of woods, thickets and clearings. South end of Lake Placid. June.

C. laxiflora *var.* **patulifolia** (*Dewey*) *Carey*

With the typical form.

C. laxiflora *var.* **varians** *Bailey*

Woods and clearings. Common.

Carex plantaginea *Lam.*

PLANTAIN LEAF SEDGE

Wooded hillside near Wood's sap works. June.

Carex altocaulis (*Dewey*) *Britton*

C. Saltuensis Bailey

SHEATHED SEDGE

Swampy woods east of Wood farm. Rare. June. The other known locality for this sedge in our state is Bergen swamp in Genesee county.

Carex pedunculata *Muhl.*

LONG STALKFD SEDGE

Woods between the south end of Lake Placid and Newman. June.

Carex scirpoidea *Mx.*

SCIRPUS-LIKE SEDGE

Top of Wallface mountain. June and July.

Carex deflexa *Hornem.*

C. deflexa var. *Deanei* Bailey

NORTHERN SEDGE

Lumber road near Mud pond, and Notch road. June. The small form of the species, which in the *Manual* is taken as the typical form, occurs occasionally on the mountain sides. Its staminate spike is less conspicuous. It was collected many years ago on the south side of Mt Whiteface.

Carex pedicellata (*Dewey*) *Britton*

C. communis Bailey

FIBROUS ROOTED SEDGE

Thin woods and clearings. Common. June.

C. pedicellata Wheeleri (*Bailey*) *Britton*

C. communis var. *Wheeleri* Bailey

Road to Mud pond. The variety is chiefly distinguished by its shorter leaves and short staminate spike. The closely related *C. Pennsylvanica* Lam. is apparently absent.

Carex Novae-Angliae *Schw.*

NEW ENGLAND SEDGE

Woods and open places. Lumber road to Owen pond. June.

Carex leptalea *Wahl.*

C. polytrichoides. Muhl.

BRISTLE STALKED SEDGE

Swamps and wet places. Common. June.

Carex pauciflora *Lightf.*

FEW FLOWERED SEDGE

Marshes. Rare. Averyville swamp. June and July. This singular sedge is found on the top of Mt Marcy.

Carex stipata *Muhl.*

AWL FRUITED SEDGE

Swales, ditches and low grounds. Common. June and July.

Carex vulpinoidea *Mx.*

FOX SEDGE

Roadsides and meadows. Raybrook. August. This sedge is abundant in many places but rare in North Elba.

Carex tenella *Schk.*

SOFT LEAVED SEDGE

Shores and swamps. Clear lake and swamp east of Wood farm. June and July.

Carex sterilis *Willd.*

C. echinata var. *microstachys* Boeckl., *C. echinata* var. *angustata* Bailey

LITTLE PRICKLY SEDGE

Low meadows and along streams. Common. June and July.

C. sterilis cephalantha *Bailey*

With the typical form but less common.

Carex canescens *L.*

SILVERY SEDGE

Swamps and shores. Round lake, Marsh pond and Wood farm swamp. June.

Carex brunnescens (*Pers.*) *Poir.*

C. canescens var. *alpicola* Wahl.

BROWNISH SEDGE

Top of Mt McIntyre. It is found on the top of Mt Marcy also. July and August.

C. brunnescens gracilior *Britton*

C. canescens var. *vulgaris* Bailey

Very plentiful in woods and open places in either wet or dry soil. June. This sedge is closely allied to the two species with which it has been associated as a variety by different authors. It is probably a distinct species. It maintains its characters when growing side by side with *C. canescens*, and it fruits earlier than *C. brunnescens* and is less rigid and less brown in maturity.

Carex trisperma *Dewey*

THREE FRUITED SEDGE

Swampy woods and open bogs. Common. July.

Carex Deweyana *Schw.*

DEWEY'S SEDGE

Dry soil in woods and pastures. Common. June.

Carex tribuloides moniliformis (*Tuckm.*) *Britton*

C. tribuloides var. *reducta* Bailey

BLUNT BROWN SEDGE

Thin woods and clearings. Common. July and August. The typical form of the species has not been found here so far as I know.

Carex scoparia *Schk.*

POINTED BROWN SEDGE

Ditches, roadsides and swales. Common. July and August.

C. scoparia minor *Boott*

Habitat similar to that of the type. It is known by its smaller size, more narrow leaves and smaller brown heads.

The yellow sedge, *C. flava* L., is abundant in many parts of the Adirondacks, but is wanting in North Elba. More extensive search may yet reveal it and also several other species of this large genus.

GRAMINEAE

Panicum capillare *L.*

WITCH GRASS. TUMBLEWEED

Gardens and cultivated fields. Common. August.

Panicum dichotomum *L.*

FORKED PANIC GRASS

Pastures and thin woods. Near the school house south of Newman. August.

Panicum Crus-galli *L.*

BARNYARD GRASS. COCK SPUR GRASS

Barnyards and waste places. Common. August.

Ixophorus viridis (*L.*) *Nash*

Setaria viridis Bv.

GREEN FOXTAIL GRASS

Cultivated ground. Raybrook. August. Introduced and generally associated with *Ixophorus glaucus* (L.) Nash, but this species was not seen in North Elba.

Savastana alpina (*Sw.*) *Scrib.*

Hierochloe alpina R. & S.

ALPINE HOLY GRASS

Top of Mt McIntyre. June. Limited in our state to cold elevated places.

Oryzopsis asperifolia *Mx.*

WHITE GRAINED MOUNTAIN RICE

Dry woods. Common. Plentiful along the Notch road. June.

Milium effusum *L.*

TALL MILLET GRASS

Head of Cascade lake. June.

Muhlenbergia Mexicana (*L.*) *Trin.*

MEXICAN MUHLENBERGIA. MEADOW MUHLENBERGIA

Raybrook. August. A leafy and much branched species.

Brachyelytrum erectum (*Schreb.*) *Bv.*

B. aristatum Bv.

AWNED BRACHYELYTRUM

Woods. Common. July and August.

Phleum pratense *L.*

TIMOTHY. HERD'S GRASS

Introduced and cultivated extensively for hay, but naturalized and growing freely almost everywhere. July and August.

Alopecurus geniculatus *L.*

MARSH FOXTAIL

Moist ground. Ausable valley. July.

Agrostis alba *L.*

FIORIN. WHITE BENT GRASS

Common in low wet ground. Introduced and thoroughly naturalized. July and August.

A. alba vulgaris (*With.*) *Thurber*

RED TOP

Meadows and pastures. Very common. Introduced and naturalized. A small fine grass but an excellent fodder and pasture grass. Good for lawns.

Agrostis perennans (*Walt.*) *Tuckm.*

THIN GRASS

Wet places and along streams in woods. Common. August.

Agrostis rubra *L.*

A. canina L. (in part)

RED BENT GRASS

Top of Mt McIntyre. August.

Agrostis hyemalis (*Walt.*) *B. S. P.*

A. scaber Willd.

ROUGH HAIR GRASS

Meadows, pastures and clearings in wet or dry soil. Very common July and August.

Cinna arundinacea *L.*

WOOD REED GRASS

Cool wet places. Indian pass. August. Less common than the next following species from which it may be distinguished by its longer spikelets.

Cinna latifolia (*Trev.*) *Griseb.*

C. pendula Trin.

SLENDER WOOD REED GRASS

Wet places in woods. Common. August.

Calamagrostis Canadensis (*Mx.*) *Bv.*

BLUE JOINT. BLUE JOINT GRASS

Along streams, in low ground or wet places and on mountain tops. Very common. Abundant in some parts of Averyville swamp where it is sometimes cut for hay. It has deep subterranean root stocks by which it spreads. This may explain its habit of growing in patches.

Pickering's reed grass, *C. breviseta* Scrib., (*C. Pickeringii* Gray) grows abundantly on Beaver meadows in some parts of the Adirondack region, but I have not seen it in North Elba.

Deschampsia flexuosa (*L.*) *Trin.*

WAVY HAIR GRASS

Dry rocky soil. Top of Mt McIntyre and in Indian pass. July and August.

Trisetum subspicatum (*L.*) *Bv.*

T. subspicatum var. *molle* Gray

NARROW FALSE OAT

Rocky places. Top of Wallface mountain. June.

Avena striata *Mx.*

PURPLE OAT

Dry soil. Common. June.

A. striata pallida *Pk.*

Growing with the typical form but differing from it in having a pale panicle with no purple hues in the spikelets.

Danthonia spicata (*L.*) *Bv.*

WILD OAT GRASS

Roadsides, pastures and worn out meadows. Very common. July. A small grass with tough wiry stems. As the meadows become impoverished this grass makes its appearance in them and unless their fertility is renewed it soon takes complete possession. It makes poor hay.

Dactylis glomerata *L.*

ORCHARD GRASS

Introduced and naturalized. Occasional. July. An early and valuable grass growing freely even in shade.

POA

	Panicle narrow, culm distinctly flattened	compressa
	Panicle spreading, culm terete or slightly flattened	1
1	Culms less than a foot long	annua
1	Culms more than a foot long	2
2	Spikelets very numerous, less than 2 lines long	flava
2	Spikelets 2 lines long or more	3
3	Spikelets crowded, sessile or on short pedicels	pratensis
3	Spikelets scattered, on slender pedicels	alsodes

Poa compressa *L.*

WIRE GRASS. FLAT STEMMED MEADOW GRASS. ENGLISH BLUE GRAS

Dry rocky or sandy soil. Very common and very variable. June and July.

Poa annua *L.*

ANNUAL MEADOW GRASS. LOW SPEAR GRASS

Roadsides and waste places. Common. July to August. A pale green introduced grass of small size and often of a spreading or half prostrate habit.

Poa flava *L.*

P. serotina Ehrh.

FALSE RED TOP. FOWL MEADOW GRASS

Low wet ground and swales. Common. August. This is reputed to be an excellent grass for hay.

Poa pratensis *L.*

JUNE GRASS. KENTUCKY BLUE GRASS

Meadows, pastures and roadsides. Very common. June. Early in the season this appears to be the principal grass in the meadows of North Elba, but later, timothy overtops it and hides it from view.

Poa alsodes *Gray*

GROVE MEADOW GRASS

Woods, groves and shaded places. June. Lake Placid and old Keene road.

PANICULARIA

	Spikelets 6 lines long or more	fluitans
	Spikelets less than 6 lines long	1
1	Panicle elongated, narrow, with erect branches	elongata
1	Panicle not elongated, branches not erect	2
2	Spikelets turgid, 1.5 lines broad or more	Canadensis
2	Spikelets not turgid, less than 1.5 lines broad	3
3	Spikelets less than 2 lines long	nervata
3	Spikelets 2 lines long or more	4
4	Culms stout, spikelets commonly purplish	Americana
4	Culms slender, weak, spikelets pale	pallida

Panicularia Canadensis (*Mx.*) *Kuntze*

Glyceria Canadensis Trin.

RATTLESNAKE GRASS

Low ground, shores and wet places. Common. August.

Panicularia elongata (*Torrey*) *Kuntze*

Glyceria elongata Trin.

LONG MANNA GRASS

Wet places in woods and swamps. Raybrook. August.

Panicularia nervata (*Willd.*) *Kuntze*

Glyceria nervata Trin.

NERVED MANNA GRASS

Low wet meadows and swamps. Common. July and August.

Panicularia Americana (*Torrey*) *MacM.*

Glyceria grandis Wats.

REED MEADOW GRASS

Wet places in meadows and pastures. Raybrook. August.

Panicularia pallida (*Torrey*) *Kuntze*

Glyceria pallida Trin.

PALE MANNA GRASS

Water holes. Raybrook and old Keene road. August.

Panicularia fluitans (*L.*) *Kuntze*

Glyceria fluitans R. Br.

FLOATING MANNA GRASS

Shallow water and wet places. Raybrook. August.

Festuca ovina *L.*

SHEEP FESCUE GRASS

Roadside. Lake Placid. June. This grass was probably introduced here. It is the only fescue grass observed in North Elba.

Bromus ciliatus *L.*

FRINGED BROME GRASS. WOOD CHESS

Woods. Near the Notch house. August. The form having the flower scales everywhere pubescent is very common here. It is the prevailing form in the Adirondacks. It is *B. purgans* L., but is generally considered a form of *B. ciliatus*, though it has a different appearance.

Agropyron repens (*L.*) *Bv.*

QUACK GRASS. QUICK GRASS. COUCH GRASS

Fields and waste places. Raybrook. August. A troublesome weed in gardens and cultivated fields, and fortunately rare in North Elba.

Agropyron caninum (*L.*) *R. & S.*

AWNED WHEAT GRASS. FIBROUS ROOTED WHEAT GRASS

Dry sandy or rocky soil. Fields and roadsides. Along the railroad at Raybrook and near North Elba post office. July and August. This is a peculiar form often having awns shorter than the flower scales.

The spikelets are sometimes tinged with purple and the lower sheaths are sometimes downy. It has no creeping subterranean rootstocks.

Elymus Canadensis *L.*

NODDING WILD RYE

Valley of the Ausable near the upper iron bridge and near the Notch house. August.

Elymus Virginicus *L.*

VIRGINIA WILD RYE

Banks of the Ausable near the Notch house, August.

SPORE-BEARING PLANTS

PTERIDOPHYTA

FERNS AND FERN ALLIES

EQUISETACEAE

Equisetum arvense *L.*

FIELD HORSETAIL

Fields and roadsides. Common. May.

Equisetum sylvaticum *L.*

WOOD HORSETAIL

Swampy woods and wet places. Common. May and June.

Equisetum fluviatile *L.*

E. limosum L.

SWAMP HORSETAIL

Shallow water of lakes and sluggish streams. Lake Placid and Mirror lake. August.

LYCOPODIACEAE

Lycopodium Selago *L.*

FIR CLUB MOSS

Top of Mt McIntyre and in Indian pass.

Lycopodium lucidulum *Mx.*

SHINING CLUB MOSS

Woods. Common. This and the preceding species produce their spore cases in the axils of the leaves.

Lycopodium annotinum *L.*

STIFF CLUB MOSS

Hidden swamp, Indian pass and side of Mt McIntyre near the open summit.

L. annotinum pungens *Spring*

Open summit of Mt McIntyre. This variety differs from the type in its shorter, more sharply pointed and usually more erect leaves.

Lycopodium obscurum *L.*

L. obscurum var. *dendroideum* D. C. Eaton

GROUND PINE. TREE CLUB MOSS

Woods and open places. Common. August. This ascends to the top of Mt McIntyre, but I have seen no fertile specimens there. This club moss is easily known by its tree-like form. The *L. obscurum* of the *Manual* is a form having the upper row of leaves smaller than the others and appressed to the branches. It is more rare than the other form and not recognized as a distinct variety in *Illustrated flora.* I have not seen it in North Elba.

Lycopodium clavatum *L.*

RUNNING PINE. CLUB MOSS

Thin woods, old clearings and groves of young coniferous trees. Common. August. A beautiful species.

Lycopodium complanatum *L.*

TRAILING CHRISTMAS GREEN. FESTOON GROUND PINE

Habitat as in the last. Both are used in decorative work in the holiday season and are excellent for wreaths and festoons.

L. complanatum Chamaecyparissus D. C. Eaton

Abundant on dry hillocks south of the railroad near Raybrook.

FILICES

Polypodium vulgare *L.*

COMMON POLYPODY

Woods and shaded places, often on rocks or large boulders. Common.

Adiantum pedatum *L.*

MAIDENHAIR

Damp places in woods. Near Wood's sap works.

Pteris aquilina *L.*

BRAKE. BRACKEN

Thin woods and open places, mostly in dry soil. Common.

Asplenium acrostichoides *Sw.*

A. thelypteroides Mx.

SILVERY SPLEENWORT

Damp or wet places in woods. Wood's sap works.

Asplenium Filix-foemina (*L.*) *Bernh.*

LADY FERN

Woods and roadsides. Common. The form with narrow fronds occurs occasionally. It is sometimes recognized as a variety under the name *A. Filix-foemina angustum* (Willd.)

Dryopteris Thelypteris (*L.*) *Gray*

Aspidium Thelypteris Sw.

MARSH SHIELD FERN

Swamps and wet places. Common.

Dryopteris Noveboracensis (*L.*) *Gray*

Aspidium Noveboracense Sw.

NEW YORK FERN

Swamps and wet places. Common. Resembling the last species but having more delicate fronds with the lower pinnae gradually shorter and the veins of the segments simple.

Dryopteris spinulosa (*Retz.*) *Kuntze*

Aspidium spinulosum Sw.

SPINULOSE SHIELD FERN

On and near the top of Mt McIntyre. In the Adirondacks the typical form of the species is found in more elevated places than the variety.

D. spinulosa intermedia (*Muhl.*) *Underw.*

Aspidium spinulosum var. *intermedium* D. C. Eaton

Woods. The most abundant form of the species.

Dryopteris cristata (*L.*) *Gray*

Aspidium cristatum Sw.

CRESTED SHIELD FERN

Swamps and swampy woods. Common.

Dryopteris marginalis (*L.*) *Gray*

Aspidium marginale Sw.

MARGINAL SHIELD FERN. EVERGREEN SHIELD FERN

Woods. Rare. Wood's sap works.

Dryopteris acrostichoides (*Mx.*) *Kuntze*

Aspidium acrostichoides Sw.

CHRISTMAS FERN

Rocky places. Rare. Newman farm. A pretty evergreen fern.

Cystopteris fragilis (*L.*) *Bernh.*

BRITTLE FERN

Rocks and wet places. Pulpit rock and Rocky hill

Cystopteris bulbifera (*L.*) *Bernh.*

BULBLET CYSTOPTERIS

Wet places and rocky cliffs. Rare. Newman farm.

Onoclea sensibilis *L.*

SENSITIVE FERN

Wet places and swamps. Common. August.

Onoclea Struthiopteris (*L.*) *Hoffm.*

OSTRICH FERN

Moist or wet places. Near the Notch house and on Newman farm

Woodsia Ilvensis (*L.*) *R. Br.*

RUSTY WOODSIA

Rocks and precipices. Pulpit rock and Indian pass.

Dicksonia punctilobula *(Mx.) Gray*

D. pilosiuscula Willd.

HAIRY DICKSONIA. HAY SCENTED FERN

Roadsides and pastures, often in stony places. Near Freemans Home. July and August.

Osmunda Claytoniana *L.*

CLAYTON'S FERN

Roadsides and pastures. Common. June.

Osmunda cinnamomea *L.*

CINNAMON FERN

Wet places. Wood farm swamp. June and July.

OPHIOGLOSSACEAE

Botrychium Virginianum *(L.) Sw.*

VIRGINIA GRAPE FERN

Thin woods. Adirondack lodge road. August.

Botrychium obliquum *Muhl.*

B. ternatum var. *obliquum* D. C. Eaton

OBLIQUE GRAPE FERN

Old clearings and pastures. Near Mountain View house. August.

Botrychium matricariaefolium *A. Br.*

MATRICARY GRAPE FERN

Thin woods and open places. Raybrook. August.

Several interesting ferns have been found within a short distance of the town line but not within its limits. Among these are the alpine Woodsia, *Woodsia alpina* (Bolt.) S. F. Gray, (*W. hyperborea* R. Br.) and the fragrant shield fern, *Dryopteris fragrans* (L.) Schott., (*Aspidium fragrans* Sw.). Both have been found on rocky cliffs at Cascade lake near the east line, and at Avalanche lake near the south line. *Botrychium lanceolatum* (S. G. Gmel.) Angs. and *Pellaea Stelleri* (S. G. Gmel.) Watt., (*Pellaea gracilis* Hook.) have also been found at Cascade lake. The latter is limited to a small place near the top of the cascade where there is a deposit of crystalline limestone.

SELAGINELLACEAE

Isoetes echinospora Braunii (*Durieu*) *Engelm.*

BRAUN'S QUILLWORT

Shallow water along the shore of Lake Placid near Whiteface inn. August and September. Discovered there by Prof. N. L. Britton.

BRYOPHYTA

MOSSES AND LIVERWORTS

SPHAGNACEAE

Sphagnum acutifolium *Ehrh.*

Swamps and marshes. Common.

S. acutifolium viride *Warnst.*

Tom Peck pond. Mrs E. G. Britton. Green above, faded below.

S. acutifolium purpureum *Schimp.*

Averyville swamp. Known by its purplish color and dense head.

Sphagnum strictum *Lindb.*

S. Girgensohnii Russ.

Marshes, wet places and mountains. Near Mud pond.

S. strictum stachyodes (*Russ.*)

Averyville swamp and top of Mt McIntyre. Usually densely branched with more or less erect or ascending branches. Sterile. Mrs Britton found fine specimens along the edges of slides on Mt Whiteface.

Sphagnum Russowii *Warnst.*

Marshes and along slides of mountains. In a marsh near Scotts ponds. Varieties *virescens* Russ. and *poecilum* Russ. were found on the slope and slides of Mt Whiteface by Mrs Britton.

Sphagnum quinquefarium (*Braithw.*) *Warnst.*

Wet or dripping rocks and cliffs. Rocky hill near Wood farm. It may be recognized by the five-ranked arrangement of the branch leaves. Our specimens are of a green color and are probably referable to variety *viride* Warnst.

Sphagnum intermedium *Hoffm.*

S. recurvum Bv.

Bogs and marshes. Near Whiteface inn. Mrs Britton. The specimens are referable to variety *mucronatum* Russ.

Sphagnum Wulfianum *Girgens.*

Swamps and marshes. South Meadow and Ausable valley. This species is easily known by the number of branches in a cluster. They are more numerous than in any of our other species of peat moss, and range from seven to 14.

Spagnum squarrosum *Pers.*

Bogs and wet places. Common. This is a beautiful species and easily recognizable by the squarrose leaves of the branches.

Sphagnum cymbifolium *Ehrh.*

Bogs, marshes and wet rocks. Common.

Sphagnum medium *Limpr.*

Similar to the last in habitat and general appearance, but distinguished to some extent externally by its variegated coloration and its few branches in a fascicle. These are two to four, one or two of which are usually horizontally spreading or curved upward.

Vicinity of Lake Placid. Prof. G. F. Atkinson.

S. medium roseum *Röll.*

Bog at the outlet of Echo pond. Mrs Britton.

S. medium purpurascens *(Russ.) Warnst.*

Bog near Lake Placid. Mrs Britton.

Sphagnum Pylaesii *Brid.*

Wet rocks on mountains and muddy ground in lower places. Scotts pond. Sterile. This moss is found on wet rocks on Mt Marcy and at Avalanche lake. It is *Sphagnum Pylaiei* in the *Key to the genera and species of North American mosses.*

Sphagnum sedoides *Brid.*

Wet rocks on mountains. Mt McIntyre. Sterile. Mrs Britton remarks that it forms dense cushions resembling the mossy stonecrop. It is considered by some to be a variety of the preceding species from which it differs in having the stem simple or sparingly branched.

The very rare *Sphagnum Lindbergii* Schimp. occurs on the slide of Mt Whiteface. This is its only known station in our state.

ANDREAEACEAE

Andreaea petrophila *Ehrh.*

Bare rocks specially on mountains. Mt McIntyre and Indian pass. Mt Jo and cliffs near Scotts ponds. Mrs Britton. It forms cushion-like tufts, which are brown, reddish brown or almost black. Its capsules are small and inconspicuous and when mature, split into four valves.

BRYACEAE

Rhabdoweisia denticulata *B. & S.*

Wet rocks and cliffs. Mt Jo. Mrs Britton. Mt Pitchoff and Rocky falls.

Rhabdoweisia fugax *B. & S.*

Cliffs of Mt Jo. Rare. In small quantity but usually fertile. Mrs Britton.

Cynodontium virens Wahlenbergii *B. & S.*

Oncophorus Wahlenbergii Brid.

Decaying wood and prostrate trunks of trees. Moose island, Mt Colburn, Indian pass and Avalanche trails. Mrs Britton. Wood farm swamp and Scotts ponds. May and June. The dry capsule is shorter, more curved and less constricted under the mouth than in the typical form of *C. virens*. It is now generally considered a distinct species.

Trematodon ambiguus (*Hedw.*) *Hornsch.*

Bare ground and roadsides. Near Lake Placid. Miss N. L. Marshall. Near Notch house. July to September. A pretty moss easily recognized by the long narrow neck of the capsule. Not common in North Elba but occurring throughout the Adirondack region.

Dicranella heteromalla (*Dill.*) *Schimp.*

Ground, banks by roadsides and about roots of trees. Common. Mrs Britton remarks that the form growing on roots of trees along trails in the woods is smaller than the usual form, has the capsules less symmetric and the pedicels curved though these become straight in drying.

D. heteromalla orthocarpa *C. Mull.*

McIntyre trail near the timber line.

Dicranum fulvellum (*Dixon*) *Smith*

Crevices of rocks. Mt McIntyre. Mrs Britton

Dicranum montanum *Hedw.*

Decaying wood and base of trees. Common. Fertile.

Dicranum viride *Schimp.*

Campylopus viridis S. & L.

Prostrate trunks of trees and base of living trees. Usually sterile, but fertile specimens were found at South Meadow and on the trail to Wilmington notch. Easily known by its broken leaves. Mrs Britton.

Dicranum flagellare *Hedw.*

Decaying wood. Common. Easily known by the slender upright flagellae which form young branches and suggest the specific name. A peculiar form was found by Mrs Britton near Whiteface inn. Its stems are long and slender, its flagellae few and its leaves secund.

Dicranum fulvum *Hook.*

D. interruptum Brid.

Rocks and boulders. Common. August and September.

Dicranum longifolium *Hedw.*

Rocks and trunks of trees. Mt Jo, Avalanche trail and outlet of Lake Placid. Less common in fruit, but conspicuous by its glossy leaves when dry. Mrs Britton. Marcy trail and Indian pass.

Dicranum Sauteri *B. & S.*

Dead branches of spruce and balsam fir. Marcy trail and Mt McIntyre, also near Lake Placid. Closely related to the preceding species from which it differs in its more tapering leaves which are less serrulate and have more conspicuous auricles at the base. Not before recorded in this state. It forms dense round cushions of a yellowish green color. Mrs Britton.

Dicranum fuscescens *Turn.*

Decaying wood and rocks. Common.

Dicranum congestum *Brid.*

Rocks. Cobble hill and Indian pass. It forms more dense cushions than the preceding species. Mrs Britton. In the *Manual* this is united with *D. fuscescens* Turn.

Dicranum elongatum orthocarpum *Schimp.*

Top of Mt McIntyre. Sterile. Fertile specimens were obtained on Mt Marcy.

Dicranum scoparium (*L.*) *Hedw.*

Ground, decaying wood and rocks. Common and variable. It grows in very diverse locations and adapts itself to its surroundings, being either lax or densely tufted. Mrs Britton.

Dicranum Drummondi *Muell.*

Boggy places. Borders of Echo lake, Clear lake and Lake Placid. A large coarse moss with clustered pedicels. Mrs Britton.

Dicranum undulatum *Turn.*

Ground and rocks. Raybrook. This also has clustered pedicels, but it is easily distinguished from the preceding species by its undulate leaves.

Dicranum Schraderi *W. & M.*

Boggy places and wet rocks. Sterile specimens were found by Mrs Britton on the summit of Cobble hill. It is *D. Bergeri* Bland.

Dicranum Starkii *W. & M.*

Rocks. Indian pass. Distinguished from *D. Blytii* B. & S. by its longer capsule and more secund leaves.

Dicranodontium longirostre *B. & S.*

Decaying wood and rocks. Adirondack lodge and McIntyre trail. Sterile. Fertile specimens were found by Mrs Britton on rocks in Wilmington notch.

Fissidens osmundoides *Hedw.*

Crevices of rocks. Indian pass. Rare. June.

Fissidens adiantoides *Hedw.*

Wet rocks and moist ground. Mt Jo and Mt Colburn. Mrs Britton. Rocky hill. June. In this species the fruit is lateral, in the preceding, it is terminal.

Leucobryum vulgare *Hampe*

Bare ground, commonly under trees. Mt Jo, Clear lake and Cobble hill. Fertile specimens were found on Buck island. Mrs Britton.

Ceratodon purpureus *Brid.*

Ground, crevices of rocks, burnt places, decaying and charred wood and old shingle roofs. Common. May and June. This moss ascends to the top of the highest peaks of the Adirondacks.

Blindia acuta *B. & S.*

Rocks. Mt Jo and at the cascades of McIntyre trail, also on Pulpit rock near the water line. Mrs Britton. Rocks at the head of Cascade lake and on Mt Pitchoff.

Didymodon cylindricus *B. & S.*

Under cliffs. Mt Jo. Sterile. Mrs Britton.

Leptotrichum tortile *Muell.*

Ground by roadsides. Adirondack lodge and Lake Placid. Mrs Britton. Raybrook.

Leptotrichum vaginans (*Sull.*) *L. & J.*

Ground in pastures. Wood farm.

Barbula tortuosa *W. & M.*

Rocks and cliffs. Indian pass. Commonly sterile.

Grimmia apocarpa *Hedw.*

Rocks. Mt Jo and Mt Colburn. Mrs Britton.

G. apocarpa gracilis *N. & H.*

Dry rocks. Summit rock in Indian pass. Mrs Britton. Old Keene road near the base of Mt Pitchoff. This moss is so very unlike the typical form in its general appearance that it would seem to be better to consider it a distinct species.

Grimmia ovata *W. & M.*

Rocks. Summit of Mt McIntyre. Mrs Britton.

Racomitrium aciculare *Brid.*

Rocks in and along streams. Rocky falls. Mrs Britton. Along the stream north of Indian pass.

Racomitrium Sudeticum *B. & S.*

Rocks. Mt Jo, Scotts ponds, Ausable river and Cobble hill. Mrs Britton. Mt McIntyre and Indian pass.

Racomitrium microcarpum *Brid.*

Rocks. Mt Jo and Scotts ponds. Mrs Britton. Mt McIntyre and Indian pass.

Racomitrium fasciculare *Brid.*

Rocks. Mt Jo and summit of Mt McIntyre. Mrs Britton. Plentiful in Indian pass.

Hedwigia ciliata *Ehrh.*

Rocks. Common. June.

H. ciliata viridis *Schimp.*

Rocks. Newman farm. A very slender form occurs on rocks in Indian pass.

Zygodon viridissimus (*Dicks.*) *Brown*

On an old sugar maple near Adirondack lodge, growing with *Bryum roseum* and other mosses. Very rare. Sterile. This species has been collected only three times in North America, and has not yet been found in fruit. It has probably been often overlooked on account of its small size and its habit of growing under and among other mosses. It rarely fruits in Europe. It bears some resemblance to species of Barbula. Its bright green tufts emerge from cracks in the bark, beneath which the main stems seem to creep. Mrs Britton.

Orthotrichum speciosum *Nees.*

Trunks of trees. Placid club tract on *Populus grandidentata* and *Salix Bebbiana* Mrs Britton. Brewster farm on *Crataegus punctata* and on aspen near Freemans Home.

Orthotrichum Ohioense *S. & L.*

Trunks and branches of trees. Placid club tract, where it is associated with the preceding species, from which it may be distinguished by its smaller size, by its thin capsule partly buried in the leaves and striate when dry and by its less hairy calyptra. Mrs Britton. On beech and birch near Freemans Home and on striped maple. Wood farm.

Orthotrichum Braunii *B. & S.*

O. strangulatum Sull., not Bv.

Trunks of trees. Common. Often associated with the preceding species, from which it may be distinguished by its thicker, darker colored capsule strongly constricted under the mouth.

Orthotrichum obtusifolium *Schrad.*

Trunks of poplar or American aspen, *Populus grandidentata* and *P. tremuloides*. Placid club tract. Mrs Britton. Near Mountain View house and on Buck island. Easily known by its blunt leaves.

Ulota Hutchinsiae *Schimp.*

Orthotrichum Americanum Bv.

Rocks. Lake Placid. Miss Marshall. Brewster farm and Indian pass. June and July.

Ulota Ludwigii *Brid.*

Trunks and branches of trees. Common. June and July.

Ulota crispa *Brid.*

Trunks and branches of trees. Common. July.

Ulota crispula *Brid.*

Habitat and general appearance the same as in the preceding species. In both, the leaves are much crisped when dry. In this species the capsule is shorter than in *U. crispa*.

Tetraphis pellucida *Hedw.*

Georgia pellucida Rabenh.

Old stumps and much decayed wood. Common.

Schistostega osmundacea *W. & M.*

Dark damp places under overhanging rocks and upturned roots of trees. Two brook pond, Tom Peck pond and Mud pond; also in Indian pass under large boulders. Seldom fruiting. Called luminous moss, in reference to the brilliancy of the protonema. Mrs Britton. Fertile specimens were collected in June on Indian pass trail about a mile north of the entrance to the pass.

Splachnum rubrum *L.*

Growing among peat moss in a marsh near Scotts ponds. June. Mrs Britton remarks that the species of Splachnum, Tetraplodon and allied genera are among the rarest and most interesting of our mosses, because they grow only on decaying animal matter. *T. mnioides* has been collected on the summit of Mt Marcy, growing on the bones of some small rodent, and *Splachnum rubrum* has been collected in only one other station in the United States.

Funaria hygrometrica (*L.*) *Sibth.*

Bare ground and places where fire has been. Common. June. Mrs Britton says that this species, which is called cord moss, charcoal moss or cinder moss, is common but sporadic, requiring suitable but varying locations. In cities it is frequently found on stone walls or masonry and seems to acquire a lime-loving habit, being associated with such species as *Bryum caespiticium* and *Tortula muralis*. Near Lake Placid it was found on an old stone wall growing with *Ceratodon purpureus*, but it was most abundant on charred logs and wet ground, growing with *Marchantia polymorpha*.

Bartramia pomiformis (*L.*) *Hedw.*

Ground and rocks. Common. A beautiful moss with soft yellowish green leaves and a capsule so globose as to suggest the common name apple moss.

Philonotis fontana *Brid.*

Wet rocks near Lake Placid. Miss Marshall. This and the preceding species form dense cushions on rocks to the exclusion of all other species, the former preferring dry rocks in woods, the latter, wet rocks in open places. They usually fruit abundantly, their round capsules becoming horizontal and ribbed when dry. Mrs Britton.

Leptobryum pyriforme (*L.*) *Wils.*

Decaying wood and ground recently overrun by fire. Lake Placid. Mrs Britton. Ausable valley near the upper iron bridge and near Freemans Home. June and July.

Webera elongata *Schwaegr.*

Bryum elongatum Dicks.

Crevices of rocks. Mt McIntyre and Rocky falls. August. Easily recognized by its long necked suberect capsule.

Webera nutans *Hedw.*

Bryum nutans Schreb.

Damp earth, crevices of rocks and burnt ground. Very common. June.

Webera cruda *Schimp.*

Bryum crudum Schreb.

Damp ground and wet rocks. Lake Placid. Mrs Britton. Mt Pitchoff and Ausable valley. June.

Bryum bimum *Schreb.*

Ground. Mt Jo. Mrs Britton.

Bryum argenteum *L.*

Burnt ground. Wood farm. August.

Bryum roseum *Schreb.*

Decaying wood and humus about the base of trees. Lake Placid and Adirondack lodge. A large and beautiful species, its leaves forming rosettes of glossy dark green. Mrs Britton. Along Indian pass trail.

Mnium cuspidatum (*L.*) *Hedw.*

Damp ground and mossy prostrate trunks in woods or shaded places. One of the most common species of the genus. May and June.

Mnium affine *Bland.*

Wet ground, shaded banks and decaying mossy logs. Common. June. Var. *ciliare* (Grev.) Lindb. often occurs with a single pedicel to a plant and with long many celled teeth on the leaf margins. Its pedicels are usually red toward the base and the apiculus of the lid is commonly red. Mrs Britton notes that the stolons are very showy, arching over and rooting at the tips and that they are sometimes 5 inches long.

Mnium Drummondii *B. & S.*

Around the base of trees. Wood's sap works. June. This has the pedicels clustered as in the preceding species, but it is a smaller plant with synoecious inflorescence and leaf margins entire toward the base.

Mnium spinulosum *B. & S.*

Ground in woods, humus covering rocks and about the base of trees. Common. July. This species fruits a little later than the three preceding species, has the lid more distinctly beaked and the capsule with a dark rim around the mouth. Its pedicels are more often single than clustered in North Elba.

Mnium stellare *Reichard*

Thin soil covering rocks. Head of Cascade lake. Sterile. Known by its marginless leaves.

Mnium punctatum (*L.*) *Hedw.*

Wet places and on wet cliffs and stones along streams. Common. May. In this species the leaves have a thickened but entire margin.

M. punctatum elatum *Schimp.*

Bogs and borders of lakes. Lake Placid, Clear lake and Indian pass. A large showy variety that seems almost worthy of specific rank. Mrs Britton.

Aulacomnium palustre (*L.*) *Schwaegr.*

Damp ground, bogs and marshes. Shore of Lake Placid and top of Cobble hill. Mrs Britton. Wood farm swamp and Averyville swamp. June.

Aulacomnium androgynum (*L.*) *Schwaegr.*

Ground and rocks. Pulpit rock, where it forms extensive mats, and near Whiteface inn. Miss Marshall. This species may be distinguished from the preceding by its smaller size, smaller leaves and smaller capsules. Both sometimes bear slender subnaked branches, which in *A. palustre* terminate in a cluster of leaf-like bodies, but in *A. androgynum*, in a globular mass of granules.

Atrichum angustatum *B. & S.*

Catharinea angustata Brid.

Bare ground and banks by roadsides. Common.

Atrichum undulatum *Bv.*

Catharinea undulata (L.) W. & M.

Ground and banks of streams. Common. This and the preceding species are similar in general appearance. They are separated by the character of the inflorescence and the margin of the leaves.

Pogonatum brevicaule *Bv.*

Polytrichum tenue Menz.

Damp earth and shaded banks by roadsides. Raybrook. Easily known by the green coat of its persistent protonema covering the surface of the ground.

Pogonatum urnigerum (*L.*) *Bv.*

Ground and rocks. Indian pass. Rare.

Pogonatum alpinum (*L.*) *Roehl.*

Wet or dripping cliffs and moss covered rocks. Scotts ponds. Mrs Britton. Indian pass.

Polytrichum piliferum *Schreb.*

Thin soil covering rocks. Indian pass. Mrs Britton. Raybrook. Distinguished by its small size and by the leaves terminating in a long white hair-like point.

Polytrichum juniperinum *Willd.*

Roadsides and pastures. Common. June. The leaves of this species are entire on the margin and terminate in a reddish or brownish awn-like point.

Polytrichum strictum *Banks*

Bogs, swamps and high mountains. Averyville swamp and Mt McIntyre. Distinguished from the preceding species by its more slender habit, more compact mode of growth and by the dense whitish tomentum of the lower part of the stems.

Polytrichum Ohioense *R. & C.*

Ground and mossy logs and rocks in woods and shaded places. Common and beautiful. July. Its lid has a long beak and a beautiful red margin and the calyptra is shorter than the capsule.

Polytrichum commune *L.*

Ground in pastures and open places. Common. June. When the fertility of the soil begins to fail in old meadows and pastures, this species and *P. juniperinum* promptly invade the fields and soon take almost exclusive possession of the slight knolls that rise above the general level. When these haircap mosses appear in a meadow it should be taken as an indication that the land needs an application of some fertilizer and renewed cultivation.

Buxbaumia indusiata *Brid.*

Old logs in woods. Moose island and base of Cobble hill. September. Mrs Britton. This rare moss has also been found at the base of Mt Whiteface and near Lake Placid by Mrs Britton and at Horseshoe pond in St Lawrence county and near Tannersville in the Catskill mountains by myself.

Fontinalis Dalecarlica *B. & S.*

Mountain streams. Common in streams flowing into Lake Placid. Mrs Britton. Near Freemans Home.

Fontinalis antipyretica gigantea *Sull.*

Lakes and streams. Brook on the trail to Connery pond. Mrs Britton. Sluggish stream in swamp southeast of Brewster farm and in Clear lake. Mrs Britton says of these two species of Fontinalis or fountain mosses, that they are large and abundant but have not yet been collected in fruit in the Adirondack region, that the latter prefers muddy slow streams at lower elevations and the former, cold swift mountain streams at higher altitudes.

Neckera pennata *Hedw.*

Trunks of trees. Very common. This is as abundant as any moss in the region, growing on and clinging to the bark of living trees, its long graceful shoots often nearly encircling the trunks and the older stems hanging in thick cushions and occupying the trunk up to the lowest branches. It fruits abundantly and its capsules, pendent beneath the stems, are readily distinguished by their orange colored teeth. It is frequently intermingled with the very common liverwort of the region, *Porella platyphylla.* Mrs Britton.

Neckera oligocarpa *B. & S.*

Underside of overhanging rocks and crevices of huge boulders. Mt Jo. Mrs Britton.

Homalia Jamesii *Schimp.*

Rocks. Vicinity of Lake Placid where its trailing stems are frequently a foot long and where it forms dense flat glossy sheets. It differs very slightly from the European *H. trichomanoides* with which some authors consider it identical. Mrs Britton. Rocky hill and Indian pass.

Leucodon julaceus *Sull.*

Trunks of trees. Rare and small. Vicinity of Lake Placid and near John Brown's grave. This species is abundant in the town of Keene and it is remarkable that it should be so scarce in North Elba, specially as we usually find it on the same trees with *Neckera pennata* and forming cushions as large and dense as that species. Mrs Britton.

Anacamptodon splachnoides *Brid.*

Trunks of trees in dense woods. Vicinity of Lake Placid and near Adirondack lodge. This is a small and slender species but somewhat conspicuous by its dark bluish green color and its numerous urn-shaped capsules with reflexed teeth. It grows chiefly around or in knot holes kept moist by standing water, but it has been found around scars of old blazes on trees and in one station at the base of Mt Whiteface on some old wet and crumbling Polyporus. Mrs Britton.

Anomodon rostratus (*Hedw.*) *Schimp.*

Around the base of trees. Near Whiteface inn. Mrs Britton. Newman farm.

Anomodon attenuatus (*Schreb.*) *Hueben.*

Rocks and base of trees. Common in the vicinity of Lake Placid. Mrs Britton.

Anomodon apiculatus *B. & S.*

Base of trees. Common. This is the most abundant species of the genus and like *Neckera pennata* and *Leucodon julaceus* it prefers the trunks of living trees, though unlike them it is usually found at the base of the trunk where it forms dense dark green mats. Mrs Britton.

Pylaisia velutina *B. & S.*

Trunks of trees. Common. Forming delicate glossy light green patches. Mrs Britton.

Pylaisia intricata (*Hedw.*) *B. & S.*

Trunks of trees. Adirondack lodge. Less glossy and darker green than the preceding. Mrs Britton. Wood farm and near Mountain View house. Closely resembling the preceding species, but having a shorter less cylindric capsule and a shorter beak to the lid. Both species fruit freely. The genus name is variously written by different authors. Beside the form here used we have Pylaiea, Pylaisaea and Pylaisiella.

Climacium dendroides (*L.*) *W. & M.*

Damp or wet ground along streams and in swamps. Vicinity of Lake Placid. Mrs Britton. Banks of the Ausable above Brewster's mill.

The species of Climacium attract attention because of their large size and tree-like aspect. When fertile each plant usually bears from five to 20 capsules on long erect pedicels. In *C. dendroides* the lid remains attached to the columella. Both species have semiaquatic states which have been distinguished as varieties. Mrs Britton.

In the *Manual*, the principal divisions of the genus Hypnum are regarded as subgenera, but many bryologists now regard them as valid genera. We have followed the *Manual*.

THUIDIUM

Hypnum abietinum *L.*

Dry rocks. Indian pass. Sterile. Two forms were found, one having a darker green color than the other.

Hypnum Blandovii *W. & M.*

Mossy shaded places between the road and the river near the Notch house. Fertile.

Hypnum gracile *B. & S.*

Thuidium microphyllum (Lindb.) Best

Decaying wood and base of trees. Near Tom Peck pond. Not common. Mrs Britton.

Hypnum scitum *Bv.*

Base of trees. Indian pass trail and Newman farm. This may be distinguished from the preceding species by the beaked lid of the capsule and the long filiformly attenuated points of the perichaetial leaves.

H. scitum aestivale *L. & J.*

Near Lake Placid. Miss Marshall.

Hypnum delicatulum *L.*

Ground, decaying wood and rocks. Common. Two mosses, *Thuidium recognitum* Lindb. and *T. Philiberti* Limpr., are closely related to this species and are perhaps mere varieties of it. Mrs Britton remarks that none of the characters employed in distinguishing the three species are constant and that her observations of Adirondack specimens of them show great variability not only in the specific distinguishing features, but also in the general appearance of the mosses, this varying according to the character of the places in which they grow.

BRACHYTHECIUM

Hypnum laetum *Brid.*

Ground, base of trees and leaning or prostrate trunks. Vicinity of Lake Placid. This moss forms showy glossy light green mats and though seldom fruiting it is sure to be collected on account of its shining luxuriant mats. It frequently grows with *Neckera pennata* and *Bryum roseum* and has always been found on trees where *Zygodon viridissimus* was growing. Mrs Britton.

Hypnum salebrosum *Hoffm.*

Ground, decaying wood and stones. Abundant on the ground in wet places. Connery pond trail. Mrs Britton.

Hypnum velutinum *L.*

Ground and rocks. Rocky falls. Mrs Britton.

Hypnum Starkii *Brid.*

Decaying wood. Frequent. This is one of the common and characteristic species of the region. It spreads in loose mats over duff and decaying logs, partly covering chips and bits of rotten wood, forming straggling mats, generally fruiting abundantly and conspicuous by its rigid rough glossy red pedicels and horizontal or recurved capsules, which are often doubled on themselves, strongly contracted below the mouth and at first crowned with a sharp beaked lid. Mrs Britton.

Hypnum Novae-Angliae *S. & L.*

Wet places. Connery pond trail. Mrs Britton.

Hypnum rivulare *Bruch.*

Rocks and wet banks. Common about Lake Placid. It forms yellowish green mats on the banks of streams and on half submerged stones, the ends of its long tapering stems rooting. It does not often fruit abundantly. It is frequently associated with *Hypnum rusciforme*, a coarser plant with simple branches, a darker green color and a long beaked lid. Mrs Britton.

EURHYNCHIUM

Hypnum strigosum *Hoffm.*

Ground and about the base of trees. Common.

RAPHIDOSTEGIUM

Hypnum recurvans *Schwaegr.*

Roots of trees and prostrate trunks. Common.

Hypnum laxepatulum *James*

Rocks and roots of trees. Avalanche trail. Closely related to the preceding species. It seems to prefer more moist and shaded localities, occurs more frequently on rocks and usually forms thin bright green mats with more slender stems, less regularly pinnate and with less crowded and less recurved leaves. The pedicels are often only ½ inch long. Mrs Britton.

Hypnum Jamesii *L. & J.*

Near Adirondack lodge. One of the rarest species of the region. It resembles slender forms of *Pylaisia velutina* and *Hypnum reptile* with which it was collected. In high elevations it grows on spruce and balsam fir. Mrs Britton.

RHYNCHOSTEGIUM

Hypnum rusciforme *Weis*

Stones in streams. Near Whiteface inn. Mrs Britton.

PLAGIOTHECIUM

Hypnum pulchellum nitidulum (*Wahl.*) *L. & J.*

Plagiothecium nitidulum B. & S.

Base of trees. Indian pass trail.

Hypnum elegans *Hook.*

Rocks and cliffs. Mt Jo. Mrs Britton.

Hypnum Mullerianum *Hook. f.*

Prostrate trunks and decaying wood. Near Whiteface inn and on Moose island. Mrs Britton.

Hypnum sylvaticum *Huds.*

Rocks. Head of Cascade lake. July.

Hypnum Muhlenbeckii *Spruce*

Rocks and cliffs. Very common. Easily recognized by its short slender branches with spreading leaves. Mrs Britton. The lid is often tipped with red.

Hypnum denticulatum *L.*

Wet rocks and cliffs. Common and variable.

AMBLYSTEGIUM

Hypnum subtile *Hoffm.*

Base of trees. Freemans Home. A very small moss.

Hypnum serpens *L.*

Decaying wood. Freemans Home and Newman farm. June.

Hypnum radicale *Bv.*

Wet ground and damp decaying wood. Adirondack lodge. Mrs Britton.

Hypnum riparium *L.*

Swamps, water holes and borders of lakes. Lake Placid. Miss Marshall.

CAMPYLIUM

Hypnum hispidulum *Brid.*

Decaying wood and roots of trees. Rocky hill. Found near Lake Placid by Miss Marshall.

Hypnum chrysophyllum *Brid.*

Decaying wood. On arbor vitae near Adirondack lodge. Mrs Britton.

HARPIDIUM

Hypnum aduncum polycarpum *B. & S.*

Shallow water, bogs and swamps. Near Lake Placid. Miss Marshall.

Hypnum uncinatum *Hedw.*

Rocks, ground and decaying wood. Very common. June. This moss forms dense glossy cushions on rocks and old trunks of trees. On dripping cliffs the stems often become much elongated and slender. Mrs Britton.

H. uncinatum plumulosum *Schimp.*

Cliffs of Mt Jo. A very slender but quite rare form. Mrs Britton.

Hypnum fluitans *L.*

Wet rocks among peat mosses and in water holes in woods. Near Whiteface inn. Mrs Britton.

RHYTIDIUM

Hypnum rugosum *L.*

Thin soil covering rocks. Summit of Mt McIntyre. Mrs Britton. Indian pass. Sterile.

CTENIUM

Hypnum Crista-castrensis *L.*

Ground, rocks and prostrate trunks of trees. Common.

HYPNUM (*proper*)

Hypnum reptile *Mx.*

Trunks of trees and old logs. Common. Rarely on rocks. Mrs Britton. A form with capsules shorter than usual was found on rocks in Indian pass.

Hypnum fertile *Sendt.*

Prostrate trunks of trees in woods. Near Freemans Home.

Hypnum imponens *Hedw.*

Prostrate trunks. Near Lake Placid and Adirondack lodge. Mrs Britton.

Hypnum curvifolium *Hedw.*

Habitat and localities same as in the preceding species. Mrs Britton.

Hypnum Haldanianum *Grev.*

Old logs and decaying wood. Near Lake Placid and Adirondack lodge. Mrs Britton. Freemans Home.

LIMNOBIUM

Hypnum montanum *Wils.*

Banks and rocks along mountain streams. Outlet of Scotts ponds, Ausable river and Rocky falls. Mrs. Britton. Indian pass and stream flowing north from it.

Hypnum ochraceum *Turner*

Mossy rocks and stones in streams. Indian pass.

Hypnum eugyrium *Schimp.*

Wet rocks. Indian pass and base of Rocky hill.

CALLIERGON

Hypnum cordifolium *Hedw.*

Swamps, bogs and wet places. Lake Placid. Mrs Britton. Wood farm swamp.

Hypnum stramineum *Dicks.*

Peat bogs and cool shaded places. Among Sphagnum near Whiteface inn. Mrs Britton. Under huge boulders near ice deposit. Indian pass. Sterile.

Hypnum Schreberi *Willd.*

Ground and rocks, mostly in dryish places, but sometimes growing in wet places with Sphagnum. Very common. It forms deep glossy yellowish cushions brilliantly contrasting with the reindeer moss with which it usually grows. Mrs Britton.

PLEUROZIUM

Hypnum splendens *Hedw.*

H. proliferum L.

Ground, rocks and old prostrate trunks of trees. Very common. This moss ascends to the tops of the highest peaks of the Adirondacks.

It is a large and easily recognized species. Its stems are composed of a series of curved or arched segments. A new arch is formed each year, beginning its growth a little below the tip of the preceding year's formation and curving in the same direction with it. Stems many inches long are sometimes found and if they did not decay at the base as growth progresses at the upper part it would be possible to tell the age of the moss by counting the segments of the stem. They sometimes attain such a length that, when growing on boulders, they stretch across and hide the crevices between them and make it dangerous for any one to attempt to walk over such hidden pitfalls.

Hypnum umbratum *Ehrh.*

Ground and mossy rocks in woods. Common. More slender than the preceding which it somewhat resembles.

HYLOCOMIUM.

Hypnum triquetrum *L.*

Ground and base of trees. Common. A large coarse upright moss, rarely fruiting in North Elba.

JUNGERMANNIACEAE

Frullania Eboracensis *Lehm.*

Trees. A very common species occurring chiefly on trunks of deciduous trees. Its color is usually dark green or blackish.

Frullania Asagrayana *Mont.*

Trees and rocks. Common. It usually grows on trunks and branches of spruce and balsam fir. Its color is generally reddish brown. It is easily recognized under the microscope by the row of peculiar cells extending through the middle of the leaf.

Radula complanata (*L.*) *Dumort.*

Base and roots of trees. Wood farm and Indian pass trail.

Porella platyphylla (*L.*) *Lindb.*

Trunks of trees and rocks. Common. Often associated with *Neckera pennata* Hedw.

Ptilidium ciliare *(L.) Nees*

Decaying wood and cut surfaces of stumps. Common. June. Variable in color.

Trichocolea tomentella *(L.) Dumort.*

Swamps and wet places. Connery pond trail. Mrs Britton. Top of Mt McIntyre and Wood farm swamp.

Bazzania trilobata *(L.) S. F. Gray*

Woods and swamps. Not rare. Avalanche trail. Mrs Britton.

Bazzania deflexa *Underw.*

B. triangularis (Schleich.) Lindb. *Mastigobryum deflexum* Nees.

Rocks. Rocky falls. A much smaller plant than the preceding.

Lepidozia reptans *(L.) Dumort.*

Decaying wood. Mt Jo. Mrs Britton. Rocky falls.

Blepharostoma trichophyllum *(L.) Dumort.*

Decaying wood and thin soil on rocks. Indian pass.

Cephalozia multiflora *Spruce*

C. media Lindb.

Ground and decaying wood. Indian pass trail and Indian pass.

Cephalozia bicuspidata *(L.) Dumort.*

Decaying wood. Near Lake Placid. Mrs Britton.

Cephalozia curvifolia *(Dicks.) Dumort.*

Decaying wood and mossy prostrate trunks of trees. A very common and beautiful species, variable in color.

Scapania undulata *(L.) Dumort.*

Wet rocks and stones in streams. Wilmington notch trail. Mrs Britton. Mt McIntyre and northern entrance to Indian pass.

Scapania nemorosa *(L.) Dumort.*

Wet rocks. Mt Jo. Mrs Britton. Rocky hill and Indian pass. June Apparently more common than the preceding species.

Scapania apiculata *Spruce*

Prostrate decaying trunk of balsam fir. Wood farm. August. Very rare.

Diplophyllum taxifolium *Dumort.*

Ground and decaying wood. Whiteface inn. Mrs Britton. Rocky falls.

Geocalyx graveolens (*Schrad.*) *Nees*

Decaying wood and prostrate trunks. Wood farm.

Lophocolea heterophylla *Nees*

Decaying wood. Near Whiteface inn. Mrs Britton. Rocky hill and near Freemans Home.

Chiloscyphus polyanthos (*L.*) *Corda*

Wet ground and decaying wood. Shore of Clear lake. Mrs Britton.

Plagiochila asplenioides (*L.*) *Dumort.*

In a brook near Whiteface inn. Mrs Britton.

Mylia Taylori (*Hook.*) *S. F. Gray*

Damp mossy rocks. Indian pass. It has been found by Mrs Britton on Mt Marcy and Mt Whiteface.

Jungermannia setiformis *Ehrh.*

Rocks. Mt McIntyre. This is the only station where I have found this rare species.

Jungermannia ventricosa *Dicks.*

Rocks. Mt McIntyre, Indian pass and Rocky falls.

Jungermannia incisa *Schrad.*

Decaying wood. Clear lake. Mrs Britton. Ausable valley.

Jungermannia minuta *Crantz*

Rocks. Indian pass. This species occurs also on the top of Mt Marcy.

Jungermannia Michauxii *Weber*

Decaying wood and sometimes on rocks. Mt McIntyre and Indian pass.

Jungermannia Kunzeana *Huben.*

Rocks. Indian pass. A very rare liverwort.

Jungermannia Schraderi *Mart.*

Aplozia autumnalis (DC.) Schiff.

Decaying wood Whiteface inn, Moose island and Connery pond trail. Mrs Britton. Indian pass trail.

Liochlaena lanceolata *Nees*

Aplozia lanceolata (L.) Schiff.

Old logs. Connery pond trail. Mrs Britton.

Marsupella sphacelata (*Gies.*) *Dumort.*

Rocks. Indian pass. Rare.

Marsupella emarginata (*Ehrh.*) *Dumort.*

Rocks. Mt McIntyre, Mt Pitchoff and Rocky hill.

Blasia pusilla *L.*

Wet banks of streams. Near Adirondack lodge. Sterile.

Aneura latifrons *Lindb.*

Decaying wood. Mt Jo. Mrs Britton. Ausable valley.

Aneura palmata (*L.*) *Dumort.*

Near Whiteface inn. Mrs Britton.

MARCHANTIACEAE

Marchantia polymorpha *L.*

Bog hole near Whiteface inn. Mrs Britton. Ground either wet or dry; often in places recently overrun by fire. Brewster farm. June.

THALLOPHYTA

LICHENS AND FUNGI

USNEACEAE

Ramalina calicaris (*L.*) *Fr.*

Trees and shrubs; occasionally on rocks. The varieties mentioned below are found in North Elba.

R. calicaris fraxinea *Fr.*

R. calicaris fastigiata *Fr.*

R. calicaris canaliculata *Fr.*

R. calicaris farinacea *Schaer.*

The last variety grows on rocks. It is generally sterile, but easily recognized by its white powdery soredia. Pulpit rock and rocks in the eastern part of the town.

Cetraria Islandica (*L.*) *Ach.*

ICELAND MOSS

Heathy or mossy ground in cold or elevated places. Top of Mt McIntyre and in Indian pass.

Cetraria ciliaris *Ach.*

Fences, trunks and branches of trees. Very common. A small brown form is abundant on the branches of the tamarack, balsam fir and spruce. It may be distinguished from the next following species by the crenate margin of the apothecia and specially by the black fibrils of the lower surface of the thallus.

Cetraria lacunosa *Ach.*

Fences and trunks of trees. Common.

Cetraria Oakesiana *Tuckm.*

Trees and sometimes on rocks. Common on balsam fir but often sterile. Fertile specimens were collected near Freemans Home.

Cetraria juniperina Pinastri *Ach.*

Trees, shrubs and rocks. Rare. Near Lake Placid. Atkinson. Tamarack trees near Hidden swamp. A pretty yellow lichen but commonly sterile.

Evernia furfuracea (*L.*) *Mann*

Dead branches of trees. Common. Most often on coniferous trees.

E. furfuracea Cladonia *Tuckm.*

Tamarack, balsam fir and spruce. Indian pass and the cold region west of Mt Wallface. Both the species and the variety are generally sterile. The thallus in both sometimes becomes partly or almost wholly black.

Evernia Prunastri (*L.*) *Ach.*

Trunks and branches of Tamarack. Occasional. Sterile.

Usnea barbata (*L.*) *Fr.*

GRAY MOSS

Branches of trees. Common in low swampy woods and exhibiting several varieties.

U. barbata florida *Fr.*

Vicinity of Lake Placid. Atkinson. Eastern part of the town. Abundantly fertile.

U. barbata hirta *Fr.*

Known by its minute fibrils and its numerous soredia which often give it a pulverulent appearance.

U. barbata plicata *Fr.*

Vicinity of Lake Placid. Atkinson.

U. barbata dasypoga *Fr.*

This is the long slender pendulous variety with the thallus and its branches beset with spreading or horizontal fibrils. It is generally sterile. It grows from branches either dead or living and gives to the trees it inhabits a peculiar untidy and unthrifty appearance.

Usnea longissima *Ach.*

LONG GRAY MOSS

Similar to *U. barbata dasypoga* in habitat and general appearance, and sometimes growing with it, but of a paler color with a more slender and delicate thallus. It is less abundant. Sterile. Hidden swamp.

Alectoria jubata (*L.*) *Fr.*

Branches of trees. Common. Similar in habitat to species of Usnea but at once distinguished by its brown or blackish brown color. It often grows intermingled with other lichens on dead branches of tamarack, balsam fir and spruce. Sterile.

A. jubata implexa *Fr.*

This differs from the typical form in its long slender pendulous thallus.

PARMELIACEAE

Theloschistes polycarpus (*Ehrh.*) *Tuckm.*

Trees. Lake Placid. Atkinson. Bark of maple. Shore of Mirror lake.

Theloschistes parietinus (*L.*) *Norm.*

Trunks and branches of trees. Not common. Branches of a thorn tree near Mountain View house.

Parmelia perlata (*L.*) *Ach.*

Rocks and sometimes on trees. Near Lake Placid. Atkinson. Old Keene road.

Parmelia tiliacea (*Hoffm.*) *Floerk.*

Trees and shrubs. Very common.

Parmelia saxatilis (*L.*) *Fr.*

Trees and rocks. Near Mountain View house and in Indian pass.

Parmelia physodes (*L.*) *Ach.*

Trunks and branches of trees. Very common. Specially abundant on spruce and balsam fir.

P. physodes vittata *Ach.*

Habitat same as that of the species but less plentiful.

Parmelia pertusa (*Schrank*) *Schaer.*

With the preceding and resembling it but much less common. It may be distinguished from it by the small round perforations in the thallus. It is sterile with us.

Parmelia olivacea (*L.*) *Ach.*

Trees and shrubs. Common.

P. olivacea aspidota *Ach.*

Trunks of alder, *Alnus incana* Willd. Old Keene road.

Parmelia caperata (*L.*) *Ach.*

Trees and rarely on rocks. Common but sterile.

Parmelia conspersa *(Ehrh.) Ach.*

Bare rocks and boulders. Very common. It ascends to the top of Mt Marcy. The thallus is generally orbicular and adorned with numerous apothecia centrally located.

Physcia speciosa *(Ach.) Nyl.*

Trunks of willows. Banks of the Ausable.

Physcia aquila *(Ach.) Nyl.*

Trunks of trees. Wood farm and trail to Indian pass.

P. aquila detonsa *Tuckm.*

Trees. Vicinity of Lake Placid. Atkinson. Near Mountain View house.

Physcia stellaris *(L.) Wallr.*

Trees and rocks. Common. *P. stellaris aipolia* Nyl. occurs on rocks in the eastern part of the county and may yet be found in North Elba.

Physcia obscura *(Ehrh.) Nyl.*

Trees and rocks. About Lake Placid. Atkinson.

Physcia setosa *(Ach.) Nyl.*

Rocks. Brewster farm. It occurs also at Cascade lake.

Physcia adglutinata *(Floerk.) Nyl.*

Trunks of beech trees. Rare. Freemans Home.

Pyxine sorediata *Fr.*

Trunks of trees and rocks. Very common but only occasionally found fertile.

UMBILICARIACEAE

Umbilicaria Muhlenbergii *(Ach.) Tuckm.*

Bare rocks. Vicinity of Lake Placid. Atkinson. Brewster farm.

Umbilicaria Dillenii *Tuckm.*

Rocks. Pulpit rock and Indian pass. Sterile.

Umbilicaria pustulata *(L.) Hoffm.*

Bare rocks. Lake Placid. Atkinson. Top of Mt McIntyre.

U. pustulata papulosa *Tuckm.*

Rocks. Near Lake Placid. Atkinson.

PELTIGERACEAE

Sticta amplissima (*Scop.*) *Mass.*

Trees and rocks. Very common. A large fine species.

Sticta pulmonaria (*L.*) *Ach.*

Trees and rocks. Common. Often growing on the same tree with the preceding species. It once had some repute as a remedy for pulmonary diseases. The disks of the apothecia are sometimes blackened by the attacks of a parasitic fungus.

Sticta crocata (*L.*) *Ach.*

Among mosses on rocks. Vicinity of Lake Placid. Atkinson.

Sticta scrobiculata (*Scop.*) *Ach.*

Same habitat and locality as the preceding one. Atkinson.

Nephroma arcticum (*L.*) *Fr.*

Rocks. West side of Pitchoff mountain near the old Keene road. I discovered this northern lichen here many years ago and this still remains the only known station for it in our state. It is a large fine species with broad and beautiful apothecia. It is earnestly hoped that forest fires may never come near enough to destroy it.

Nephroma Helveticum *Ach.*

Trees and rocks. Freemans Home and Indian pass trail.

Nephroma laevigatum *Ach.*

Rocks. Old Keene road.

N. laevigatum parile *Nyl.*

Near Lake Placid. Atkinson.

Peltigera aphthosa (*L.*) *Hoffm.*

Damp mossy ground, shaded banks or among mosses on rocks. Common. This is easily distinguished from all our other species of Peltigera by the scattered warts of the upper surface of the thallus.

Peltigera horizontalis (*L.*) *Hoffm.*

Pulpit rock on the shore of Lake Placid.

Peltigera polydactyla (*Neck.*) *Hoffm.*

Rocks and trees. Not common. Vicinity of Lake Placid. Atkinson. Indian pass.

Peltigera rufescens (*Neck.*) *Hoffm.*

Rocks. Freemans Home.

Peltigera canina (*L.*) *Hoffm.*

Damp shaded ground, mossy banks, swamps and mossy prostrate trunks of trees. Very common.

P. canina spuria *Ach.*

Vicinity of Lake Placid. Atkinson. *P. canina spongiosa* Tuckm. was found on Mt Marcy, but was not seen in North Elba.

PANNARIACEAE

Pannaria rubiginosa (*Thunb.*) *Delis.*

Rocks and trees. Vicinity of Lake Placid. Atkinson.

P. rubiginosa conoplea *Fr.*

Habitat and locality as in the species. Atkinson.

Pannaria leucosticta *Tuckm.*

Trees and rocks. Vicinity of Lake Placid. Atkinson.

COLLEMACEAE

Ephebe pubescens *Fr.*

Rocks. Brewster farm. Sterile.

Collema nigrescens (*Huds.*) *Ach.*

Trunks of trees. Valley of the Ausable.

Leptogium tremelloides (*L. f.*) *Fr.*

Rocks and trees. Commonly sterile. Indian pass. Fertile.

Leptogium myochroum saturninum *Schaer.*

Rocks and trees. Vicinity of Lake Placid. Atkinson.

Hydrothyria venosa *Russell*

Submerged rocks. Lake Placid. Atkinson.

LECANORACEAE

Placodium vitellinum (*Ehrh.*) *N. & H.*

Rocks. Rare. Brewster farm.

Lecanora pallida (*Schreb.*) *Schaer.*

Bark of trees on which it forms conspicuous whitish spots. Common.

L. pallida cancriformis *Tuckm.*

Bark of elm. Ausable valley.

L. pallida angulosa *Hoffm.*

Bark of black cherry. H. Brown farm.

Lecanora subfusca (*L.*) *Ach.*

Trunks and branches of trees. A very common lichen.

L. subfusca allophana *Ach.*

Dead spruce. Rocky hill.

L. subfusca argentata *Ach.*

Vicinity of Lake Placid. Atkinson.

Lecanora varia (*Ehrh.*) *Nyl.*

Trees and dead wood. Vicinity of Lake Placid. Atkinson.

L. varia symmicta *Ach.*

With the last. Atkinson.

Lecanora atra (*Huds.*) *Ach.*

Trunks of beech trees. Freemans Home.

Lecanora elatine *Ach.*

Bark of coniferous trees. Swamp east of Wood farm and Indian pass trail.

L. elatine ochrophaea *Tuckm.*

Trunks of balsam fir and spruce. Wood farm.

Lecanora pallescens (*L.*) *Schaer.*

Trees and rocks. Common.

Pertusaria communis *DC.*

Trees and rocks. Common.

Pertusaria velata (*Turn.*) *Nyl.*

Trunks of trees, sometimes on rocks. Very common.

Pertusaria leioplaca (*Ach.*) *Schaer.*

Trees and rocks. Vicinity of Lake Placid. Atkinson.

Conotrema urceolatum (*Ach.*) *Tuckm.*

Trunks of trees. Occasional. Freemans Home.

Gyalecta lutea (*Dicks.*) *Tuckm.*

Bark of yellow birch. Wood farm.

Gyalecta Pineti (*Schrad.*) *Tuckm.*

Bark of trees. Vicinity of Lake Placid. Atkinson.

CLADONIACEAE

Stereocaulon tomentosum (*Fr.*) *Th. Fr.*

Ground among young spruces. H. Brown farm. The stout terete tomentose podetia or stems somewhat naked on one side and the small lateral apothecia are features of this species.

Stereocaulon paschale (*L.*) *Fr.*

Rocks and heathy ground. Common.

Pilophorus cereolus Fibula *Tuckm.*

Rocks. Rare. Near the Notch house and in Indian pass.

Cladonia pyxidata (*L.*) *Fr.*

Heathy places and base of trees. Common.

Cladonia fimbriata tubaeformis *Fr.*

Ground and decaying wood. Valley of the Ausable.

Cladonia gracilis (*L.*) *Nyl.*

Ground and decaying wood. Common and variable.

C. gracilis verticillata *Fr.*

A variety easily recognized by the proliferous cups of the podetia placed one above the other.

C. gracilis hybrida *Schaer.*

Vicinity of Lake Placid. Atkinson.

C. gracilis elongata *Fr.*

Summit of Mt McIntyre and in Indian pass.

This variety prefers cold alpine situations. It is usually sterile. It is easily recognized by its long simple or sparingly branched or forked podetia with subulate tips.

Cladonia squamosa *Hoffm.*

Heathy ground, decaying prostrate trunks and mossy rocks. Common. It ascends to the top of Mt McIntyre.

Cladonia caespiticia (*Pers.*) *Fl.*

Trees and rocks. Vicinity of Lake Placid. Atkinson.

Cladonia furcata (*Huds.*) *Fr.*

Ground and decaying wood. East of Brewster farm.

C. furcata subulata *Fl.*

With the preceding variety.

C. furcata racemosa *Fl.*

Vicinity of Lake Placid. Atkinson. Indian pass.

Cladonia rangiferina (*L.*) *Hoffm.*

REINDEER MOSS

Heathy ground. Very common. It ascends to the top of the highest Adirondack peaks. It is variable but easily recognized by its peculiar branching and bushy appearance.

C. rangiferina sylvatica *L.*

Distinguished from the typical form by its paler color.

C. rangiferina alpestris *L.*

Often growing with the typical form. It has the pale color of the preceding variety, but it is distinguished from it and the type by its dense mass of intricate or entangled branches.

Cladonia cristatella *Tuckm.*

Ground and decaying wood. Very common. It is easily known by its bright red or scarlet apothecia which crown the podetia or their short apical branches. In a single instance the form with yellowish apothecia, *ochrocarpia,* was found growing on the same piece of decaying wood that bore the typical form.

Cladonia cornucopioides *(L.) Fr.*

Heathy or mossy ground. Rare. Mt McIntyre and Indian pass. It differs from the last in its podetia, which terminate in cups instead of short branches.

Cladonia deformis *(L.) Hoffm.*

Habitat and localities the same as in the preceding species. It is not so scarce but it fruits very sparingly. The podetia are longer and covered, above at least, with a yellowish powder.

Thamnolia vermicularis *(Sw.) Schaer.*

Ground on mountain summits. Mt McIntyre and Mt Wright. Sterile. Its podetia are simple or sparingly branched, about the thickness of a goose quill, hollow and subulate or sharp pointed. They attract attention by their white color and are liable to be mistaken for the dead and bleached remains of some species of Cladonia.

LECIDEACEAE

Baeomyces aeruginosa *(Scop.) DC.*

Ground and much decayed wood. Top of Mt McIntyre and in Indian pass.

Baeomyces byssoides *(L.) Schaer.*

Ground, rocks and decayed wood. Vicinity of Lake Placid. Atkinson.

Biatora granulosa *(Ehrh.) Poetsch*

Heathy ground, decaying wood and mosses. Occasional. Mt McIntyre and near Mountain View house.

Biatora vernalis *(L.) Fr.*

Decaying wood and bark. Vicinity of Lake Placid. Atkinson.

Biatora varians *(Ach.) Fr.*

Bark of alder. Along the Ausable river.

Biatora Laureri *Hepp*

Trunks of beech. Lake Placid. Atkinson. Freemans Home.

Biatora hypnophila *Turn.*

Mosses. Freemans Home and Rocky falls.

Biatora suffusa *Fr.*

Trunks of trees. Vicinity of Lake Placid. Atkinson.

Heterothecium sanguinarium (*L.*) *Flot.*

Trees and rocks. Vicinity of Lake Placid. Atkinson. Bark of balsam fir. Mt McIntyre.

Heterothecium pezizoideum (*Ach.*) *Flot.*

Bark of balsam fir. Vicinity of Lake Placid. Atkinson.

Lecidea contigua *Fr.*

Rocks. Occasional. Brewster farm.

Buellia parasema (*Ach.*) *Th. Fr.*

Trunks of trees, specially on beech. Very common.

Buellia geographica (*L.*) *Tuckm.*

Rocks. Summit of Mt McIntyre. A beautiful rock lichen attracting the attention by the contrast of yellow and black colors it displays.

Buellia petraea (*Flot.*) *Tuckm.*

Rocks and boulders. Common.

OPEGRAPHACEAE

Graphis scripta *Ach.*

Bark of trees and shrubs. Very common.

The species of fungi are so numerous that it has seemed desirable to indicate by name the larger groups in which the families are arranged. These depend upon the character of the fructification or of the part of the plant immediately concerned in spore production. The group Hymenomyceteae, in which the spores are produced on specialized cells or basidia seated on exposed surfaces, includes by far the greater number of species and is placed first.

HYMENOMYCETEAE

AGARICACEAE

LEUCOSPORAE

Amanita phalloides *Fr.*

POISON AMANITA

Woods and bushy places. Common. July to September. Three forms occur. In one the pileus is brown or smoky brown; in another it is grayish with the center blackish or blackish brown; in the third it is white, yellowish white or pale greenish yellow. This is the prevailing form in thin woods or on the borders of woods or in bushy places. The darker colored forms occur more often in denser woods. The species is a poisonous one and probably the most dangerous one we have. It is attractive in appearance and the pale forms are too often mistaken by the unwary and careless for the common mushroom. The penalty for such mistakes may be and often is death. The persistently white lamellae and the swollen or bulbous base of the stem are characters which should enable any one to distinguish it at a glance from the common mushroom.

Amanita muscaria *L.*

FLY AMANITA

Woods and their borders, occasionally in open places. Common. July to October. A beautiful species, attractive by its red orange and yellow colors and by the adornment of its pileus with soft pale warts, but it is poisonous if eaten. Flies that sip the viscid juice of the pileus are soon killed by it. This fact is suggestive of the specific and common name.

A. muscaria formosa (*G. & R.*) *Sacc.*

In this variety the pileus is wholly pale yellow. A form intermediate between this and the type has the center of the pileus tinted with orange or red.

Amanita Frostiana *Pk.*

FROST'S AMANITA

Moist woods and thickets. A smaller plant than the preceding, but closely resembling it. It may be distinguished by its yellow stem and annulus and by the bulb of the stem which is usually definitely margined above. Not rare.

Amanita rubescens *Fr.*

REDDISH AMANITA

Woods and bushy places. Occasional. July and August. Edible. The volva is not persistent at the base of the stem in this species, but soon disappears.

Amanitopsis vaginata (*Bull.*) *Roze*

SHEATHED AMANITOPSIS

Woods and groves. Common. Edible. The pileus varies in color from ochraceous yellow to dark brown.

Lepiota procera *Scop.*

TALL LEPIOTA. PARASOL MUSHROOM

Fields and pastures. Near Newman and on Wood farm. August. Edible. I have seen no larger or finer specimens of this mushroom anywhere than those found in North Elba.

Lepiota acutesquamosa *Weinm.*

Woods. This species occurs sparingly. Generally only one or two specimens are found in a place.

Lepiota metulaespora *B. & Br.*

Moist places in woods and deep shades. The American plant differs from the typical form in having the stem loosely floccose or fibrillose.

Lepiota felina *Pers.*

Damp or mossy places in woods. Common. July and August. The pileus is beautifully adorned with dark brown scales.

Lepiota cristata *A. & S.*

Woods and open places. A small but pretty species.

Lepiota acerina *Pk.*

Prostrate trunks of sugar maple in woods. Rare. Near the sap works south of John Brown farm.

Lepiota granulosa *Batsch*

Pastures and bushy places. Common. This and the next following species depart somewhat from the generic character in having the lamellae attached to the stem.

Lepiota amianthina *Scop.*

Damp mossy ground in woods. Common. Closely allied to the preceding species but of a pale ochraceous color and generally more slender in habit. In the typical form the lamellae are adnate and the flesh of the stem is yellowish. These characters are not always well shown in our plant.

Lepiota illinita *Fr.*

Woods and groves. Rare. In a grove of young coniferous trees near the road to Epps farm. August and September. A species easily known by its pure white color and viscid pileus and stem. From similar species of Hygrophorus it may be separated by its free lamellae.

Armillaria mellea *Vahl.*

HONEY COLORED ARMILLARIA

On and about stumps and prostrate trunks. Very common and variable. It does not often appear before August, but it usually continues till cold weather stops its growth. It grows either in groups or in clusters. It is edible but not of first quality.

Tricholoma transmutans *Pk.*

CHANGING TRICHOLOMA

Woods and groves. Near Newman. September.

Tricholoma imbricatum *Fr.*

Similar in color and habitat to the last, but the pileus is not viscid. Both are edible.

Tricholoma rutilans *Schaeff.*

About stumps or decaying wood of coniferous trees. Raybrook. August.

Tricholoma variegatum *Scop.*

Decaying wood of coniferous trees. Valley of the Ausable. August.

Tricholoma vaccinum *Pers.*

Woods and groves. Near Newman. September.

Tricholoma album *Schaeff.*

Woods. Common. Very variable in size.

Tricholoma nobile *Pk.*

Woods. West side of road to Epps farm. September. Its flavor is more unpleasant and more lasting than that of the preceding species.

Tricholoma laterarium *Pk.*

Woods. Wood farm. August.

Tricholoma virescens *Pk.*

Mossy ground in thin woods. Freemans Home.

Tricholoma alboflavidum *Pk.*

Fields and pastures. Wood farm and Brewster farm. August. An attractive and handsome mushroom, but having a disagreeable flavor.

Tricholoma fallax *Pk.*

Groves of young coniferous trees. Common. Appearing after copious rains. A small species of peculiar color and closely related to *T. cerinum* Pers.

Tricholoma silvaticum *Pk.*

Mossy ground in woods. Near Newman. September.

Tricholoma subacutum *Pk.*

Woods and groves. Near Newman. September. The prominent acute umbo, hollow stem and hot peppery taste are distinguishing characters of this species.

Tricholoma microcephalum *Karst.*

Grassy ground in pastures. Near the red schoolhouse south of Newman. September.

Clitocybe media *Pk.*

INTERMEDIATE CLITOCYBE

Mossy ground in woods. Near Newman. September. Edible. An excellent mushroom but very rare.

Clitocybe anisaria *Pk.*

Among fallen leaves in woods. Raybrook. August.

Clitocybe gallinacea *Scop.*

Thin woods. Near Newman. September.

Clitocybe tumulosa *Kalchb.*

Groves of young coniferous trees. Near the road to Epps farm. September.

Clitocybe infundibuliformis *Schaeff.*

FUNNEL FORM CLITOCYBE

Thin woods and bushy places. Common. Edible.

Clitocybe Adirondackensis *Pk.*

Woods. Common. Similar to the preceding species in shape, but smaller, paler and with more narrow and crowded lamellae.

Clitocybe sinopica *Fr.*

Thin woods and clearings, specially in places recently overrun by fire. Common.

Clitocybe ectypoides *Pk.*

Decaying wood. Common. The stem is often curved and sometimes eccentric.

Clitocybe eccentrica *Pk.*

Much decayed wood in woods. Raybrook. August. White branching strands of mycelium may be found permeating the soft decayed wood. The stem is often eccentric.

Clitocybe leptoloma *Pk.*

Prostrate trunks of deciduous trees, specially of the sugar maple. Raybrook. August. Its flavor is bitter.

Clitocybe decorosa *Fr.*

Prostrate trunks and decaying wood of coniferous trees. Adirondack lodge. August.

Clitocybe Catinus *Fr.*

Fallen leaves and fragments of bark. Raybrook. August.

Clitocybe cyathiformis *Fr.*

Ground and prostrate trunks of trees in woods. Common.

Clitocybe subditopoda *Pk.*

Mossy ground in woods. Near Newman. September.

Clitocybe angustissima *Lasch.*

Low wet ground in woods. Near Newman. September.

Clitocybe Gerardiana *Pk.*

Swamps and bogs. Wood farm swamp. June.

Clitocybe laccata *Scop.*

Woods, groves and swamps. Very common. June to October. Edible but rather tough and not highly flavored. A favorite habitat of this species is under coniferous trees, specially pine trees. A genus Laccaria has been instituted by Berkeley and Broome for the reception of this and allied species, having for its principal characters, broadly adnate lamellae becoming dusted by the copious subglobose minutely warted white spores.

C. laccata pallidifolia *Pk.*

Swamps and groves. Common. Differing from the type in its paler lamellae.

C. laccata striatula *Pk.*

Wet places. Distinguished by its usually small size with its glabrous pileus so thin that it is striatulate when moist, the position of the lamellae beneath showing through it like shadowy lines.

Collybia radicata *Relh.*

ROOTING COLLYBIA

Woods. Common. Edible, but the flesh is thin and not very richly flavored. Remarkable for the long root-like extension of the stem.

C. radicata furfuracea *Pk.*

This variety differs from the typical form in having the stem sprinkled copiously with small branny scales. It is as plentiful as the typical form.

C. radicata pusilla *Pk.*

A small variety with the pileus scarcely more than an inch broad. It is most often found under beech trees.

Collybia platyphylla *Fr*

Woods and clearings on the ground and on much decayed wood. Common. June to September. A large stout species easily mistaken for a Tricholoma.

Collybia butyracea *Bull.*

Groves of young coniferous trees. Common.

Collybia maculata *A. & S.*

Damp woods and mossy ground. Common.

Collybia dryophila *Bull.*

Ground and decaying wood in woods, groves and clearings. Common and variable. June to October.

Collybia abundans *Pk.*

Prostrate trunks of coniferous trees. Common.

Collybia rugosodisca *Pk.*

Prostrate trunks of coniferous trees in woods. Indian pass trail. August.

Collybia tuberosa *Bull.*

Damp humus and decaying agarics. Common. Late in the season it produces sclerotioid tubers by which the species may easily be recognized.

Collybia ignobilis *Karst.*

Mossy ground under balsam firs. Rare. Near Newman. September.

Collybia acervata *Fr.*

Ground and much decayed wood. Common. It grows in tufts composed of many individuals.

Collybia spinulifer *Pk.*

Similar to the last in habitat and mode of growth, but the lamellae are more highly colored and they bear colored pointed setae which occur also but more sparingly on the stem and pileus.

Collybia Familia *Pk.*

Decaying wood and prostrate trunks of coniferous trees. Near Newman. September.

Collybia confluens *Pers.*

Ground in woods. Common. It may be either single or in tufts of many individuals. Sometimes the stems are so closely crowded that they are more or less united at the base. Occasionally the plants grow in lines or arcs of circles.

Collybia velutipes Curt. and *C. stipitaria* Fr. are found in many parts of the Adirondacks and will probably yet be found in North Elba.

Mycena pelianthina *Fr.*

Damp or mossy places in woods. Not rare but generally only one or two plants are found in a place.

Mycena pura *Pers.*

Among fallen leaves in woods. Common.

Mycena galericulata *Scop.*

About stumps and on decaying wood in woods and clearings. One of the most common species of this genus.

Mycena cyaneobasis *Pk.*

Decaying wood of deciduous trees. Adirondack lodge road. Easily recognized by the blue color of its mycelium.

Mycena epipterygia *Scop.*

Mossy ground and decaying prostrate trunks of trees. Common.

Mycena Leaiana *Berk.*

Dead trunks and branches of trees, specially of beech. Common. This is a beautiful orange yellow viscid species usually growing in tufts.

Mycena rorida *Fr.*

Groves of young coniferous trees in rainy weather.

Mycena palustris *Pk.*

Among peat mosses in marshes. Wood farm. June.

Mycena immaculata *Pk.*

Among mosses, fallen leaves and on naked ground. Adirondack lodge. August.

Omphalia striaepilea *Fr.*

Woods. Rare. Raybrook. August.

Omphalia lilacinifolia *Pk.*

Decaying wood of coniferous trees. Raybrook. August.

Omphalia Oculus *Pk.*

Prostrate trunks of coniferous trees. Rare. Trail to Indian pass.

Omphalia olivaria *Pk.*

Ground in woods and groves, specially where fire has been. Near Newman. July.

Omphalia umbellifera *L.*

Heathy ground and decaying wood. Common and variable in color. It ascends to the top of Mt McIntyre.

Omphalia Campanella *Batsch*

Decaying wood and prostrate trunks of coniferous trees. Very common. May to November.

Omphalia Fibula *Bull.*

Mossy ground and prostrate trunks in woods and clearings. Common.

Omphalia Swartzii *Pers.*

Similar to the last in habitat and size, but distinct in color. The pileus is pale or whitish with a brown center and the stem is brown or violaceous at the top, whitish below.

Omphalia clavata *Pk.*

Prostrate trunks of arbor vitae. Raybrook. August.

Pleurotus sapidus *Kalchb.*

SAPID PLEUROTUS

Dead wood of standing or prostrate trunks of trees. Edible.

Pleurotus ostreatus (*Jacq*) *Fr.*

OYSTER MUSHROOM

Habitat and general appearance much like the last, from which it is separable by its sessile or nearly sessile pileus and white spores. Edible when young, but soon tough and not first quality.

Pleurotus mitis (*Pers.*) *Fr.*

Dead wood of balsam fir. Near road to Epps farm. September.

Pleurotus petaloides (*Bull.*) *Fr.*

Decaying wood. Wood farm. August. *Pleurotus serotinus* Schrad. Is common in some parts of the Adirondacks and probably occurs in North Elba, but it usually appears late in the season.

Hygrophorus eburneus (*Bull.*) *Fr.*

Among fallen leaves in woods. Near the road to Epps farm. September.

Hygrophorus capreolarius *Kalchb.*

Mossy ground in woods of coniferous trees. Near the road to Averyville. September.

Hygrophorus Queletii *Bres.*

Groves of young coniferous trees. Near Newman. September.

Hygrophorus hypothejus *Fr.*

Woods. Rare. Near Newman. September.

Hygrophorus fuscoalbus (*Lasch.*) *Fr.*

Groves of young coniferous trees. Near Newman. September.

Hygrophorus pratensis (*Pers.*) *Fr.*

MEADOW HYGROPHORUS

Meadows, pastures, thin woods and clearings. Edible. It may be found from July to September. It sometimes grows under the shade of brakes.

Hygrophorus miniatus *Fr.*

VERMILION HYGROPHORUS

Damp ground in woods and mossy places, also in clearings and burnt places and sometimes among peat mosses in marshes. Common. A small but beautiful species with a red pileus and stem. Edible, tender and agreeable in flavor.

Hygrophorus Cantharellus *Schw.*

Similar to the last in color and habitat, but more slender, with a longer stem and decurrent lamellae and an unpleasant taste.

Hygrophorus congelatus *Pk.*

Banks by roadside. Near Epps farm. September.

Hygrophorus conicus (*Scop.*) *Fr.*

Thin woods and heathy bushy places. Common. It is attractive in color when fresh, but it turns black in drying. The pileus of the fresh plant varies from yellow to red or scarlet.

Hygrophorus immutabilis *Pk.*

Heathy bushy ground. Raybrook. August.

Hygrophorus marginatus *Pk.*

Damp or mossy ground in woods or their borders. Raybrook. August. Generally but few specimens occur in a place. The plants are very fragile and often irregular or split on the margin, but the colors are beautiful.

Hygrophorus parvulus *Pk.*

Damp ground in thin woods or clearings. Wood farm. August.

Hygrophorus nitidus *B. & C.*

Damp or mossy ground in woods and clearings. Common. Very viscid and pale yellow in all its parts.

Hygrophorus chlorophanus *Fr.*

Damp places in woods and clearings. Raybrook. August.

Hygrophorus psittacinus (*Schaeff.*) *Fr.*

Similar to the last in habitat. Raybrook. August.

Lactarius deliciosus (*L.*) *Fr.*

DELICIOUS LACTARIUS

Pine groves and mossy swamps. Common. Edible. The species is readily recognized by the orange colored juice that issues from wounds of the lamellae or flesh.

Lactarius uvidus *Fr.*

Swamps and mossy places in woods. Valley of the Ausable. August. Wounds of the lamellae and flesh assume a lilac or violaceous color.

Lactarius theiogalus (*Bull.*) *Fr.*

Woods and swamps. Common. The milky juice soon changes from white to yellow on exposure to the air.

Lactarius quietus *Fr.*

Low swampy woods. Rare. Near Newman. September.

Lactarius torminosus (*Schaeff.*) *Fr.*

Woods and bushy places. Common. Very acrid.

Lactarius sordidus *Pk.*

Woods and groves of coniferous trees. Lake Placid and Wood farm. Closely related to *L. turpis* Fr.

Lactarius trivialis *Fr.*

Pine groves and thin woods. Rare. Raybrook.

Lactarius hysginus *Fr.*

Woods and groves. Rare. Raybrook. August.

Lactarius affinis *Pk.*

Thin woods. East of Brewster farm.

Lactarius platyphyllus *Pk.*

Woods. East of upper iron bridge. Found but once.

Lactarius cinereus *Pk.*

Woods. Common. Known by its viscid pileus and peculiar color.

Lactarius griseus *Pk.*

Much decayed wood and mossy ground in woods. Common. Similar in color to the preceding species, but smaller and the pileus not viscid.

Lactarius glyciosmus *Fr.*

Groves of young coniferous trees. Rare. Near the red schoolhouse south of Newman. It emits a peculiar odor suggestive of the specific name.

Lactarius aquifluus *Pk.*

Woods and swamps. Occasional. Valley of the Ausable and near Epps farm. Easily known by its scanty watery juice. It is also slightly fragrant.

Lactarius deceptivus *Pk.*

Woods and groves, specially of coniferous trees. Occasional. Raybrook. August. A large thick acrid white species with a thick but soft cottony tomentum on the margin of the young pileus.

Lactarius vellerus *Fr.*

Similar to the last in habitat and general appearance, but distinguished by the close tomentose pubescence of the pileus and stem. Raybrook.

Lactarius pyrgoalus (*Bull.*) *Fr.*

Thin woods. Occasional. Adirondack lodge road.

Lactarius lignyotus *Fr.*

Woods and groves of coniferous trees. Common.

Lactarius Gerardii *Pk.*

Groves and clearings. Rare. Raybrook. August. This resembles the preceding species in color, but its stem is very short, its lamellae are wide apart and wounds do not assume a reddish hue.

Lactarius rufus (*Scop.*) *Fr.*

Mossy places in woods and swamps. Near Newman and east of Brewster farm. One of the most acrid species of the genus.

Lactarius subdulcis (*Bull.*) *Fr.*

Woods, swamps and damp places. Very common.

Lactarius camphoratus (*Bull.*) *Fr.*

Similar to the preceding species in size and habitat, but distinguished from it by its darker color and its agreeable odor. This persists a long time in the dried specimens.

Russula nigricans (*Bull.*) *Fr.*

Woods and groves, specially of pine. Raybrook. August.

Russula sordida *Pk.*

Thin woods and groves. Rare. Raybrook. August.

Russula compacta *Frost*

Woods. Occasional. Lake Placid.

Russula brevipes *Pk.*

Thin woods and open places in light soil. Rare. Raybrook. August. Closely allied to *R. delica* Fr. from which it is separated by its tardily acrid flavor and its close lamellae.

Russula basifurcata *Pk.*

Dry sandy soil in heathy bushy places. Rare. Raybrook. August.

Russula foetens (*Pers.*) *Fr.*

Woods and bushy places. Common. Easily known by its peculiar amygdaline odor.

Russula variata *Banning*

Woods. Rare. August.

Russula emetica *Fr.*

Woods and swamps. Common. Very acrid.

Russula fallax (*Schaeff.*) *Fr.*

Mossy places. Near Newman. September.

Russula fragilis (*Pers.*) *Fr.*

Mossy ground, swamps and mountains. Mt McIntyre.

Russula purpurina *Q. & S.*

Groves of young coniferous trees. Rare. Lake Placid. A beautiful but rare species.

Russula decolorans *Fr.*

Woods, groves and swamps. Common and variable.

Cantharellus brevipes *Pk.*

Woods. Very rare. Near the road to Epps farm. August. This was originally found near Ballston lake. The North Elba station is the second one in which it has been found in the state. It was here growing in the arc of a circle.

Cantharellus cibarius *Fr.*

CHANTARELLE

Woods and bushy places. Common. Edible.

Cantharellus umbonatus *Fr.*

Mossy ground in woods and clearings. Near Newman. August and September.

C. umbonatus dichotomus *Pk.*

In drier situations. In this variety the umbo is very small or wanting.

Cantharellus rosellus *Pk.*

Mossy ground and groves of young coniferous trees. Near Newman. September. Found but once.

Cantharellus infundibuliformis (*Scop.*) *Fr.*

Swamps and damp mossy places. Common. . Distinguished from all the preceding species by its slender hollow stem.

Marasmius peronatus *Fr.*

Thin woods. Near Newman. September.

Marasmius umbonatus *Pk.*

Mossy ground in woods and under coniferous trees. Common. June to August.

Marasmius papillatus *Pk.*

Mossy prostrate trunks of trees. Raybrook. August.

Marasmius acerinus *Pk.*

Dead trunks and branches of mountain maple. Near Adirondack lodge. August. Found but once.

Marasmius campanulatus *Pk.*

Woods and groves. Common.

Marasmius Rotula (*Scop.*) *Fr.*

Decaying wood, bark, branches and fallen leaves in woods. Very common.

Marasmius perforans *Fr.*

Fallen leaves of spruce. Common. The pileus varies in color from whitish to reddish brown.

Marasmius androsaceus (*L.*) *Fr.*

Fallen leaves and twigs in groves and mossy swamps. Common. The pileus varies in color as in the preceding species, from which it differs in the longer and more slender glabrous stem and in the absence of any odor.

Marasmius subvenosus *Pk.*

Fallen leaves, specially of aspen. Lake Placid. Atkinson.

Lentinus Lecomtei *Fr.*

Dead wood of deciduous trees, rarely on hemlock. Raybrook. The stem may be either central or eccentric.

Lentinus lepideus *Fr.*

Dead or decaying wood of coniferous trees. Common. June to September. Its mycelium permeates the wood and hastens its decay. It is often found growing from railroad ties. Its usually white or whitish

color varied by the darker spot-like scales makes it an attractive object. The stem is often pointed at the base. This is due to the narrow chink or crevice from which it has grown.

Lentinus cochleatus *Fr.*

Much decayed wood or mucky ground about stumps. Common. Well marked by its tufted mode of growth and furrowed stems.

Lentinus umbilicatus *Pk.*

Decaying wood and ground. Rare. Woods east of Brewster farm. August. Resembling the preceding species in color, but much smaller, with a deeply umbilicate pileus, different mode of growth and an even stem.

Lentinus ursinus *Fr.*

Decaying wood. Woods east of Brewster farm. August.

Panus stipticus (*Bull.*) *Fr.*

Dead and decaying wood. Common. A small species generally growing in tufts and easily recognized by the cinnamon colored lamellae and the short stem enlarged at the top. It has an unpleasant flavor.

Trogia crispa (*Pers.*) *Fr.*

Decaying wood and dead shrubs. Common. Often associated with *Panus stipticus*, and a favorite habitat of both is the dead trunks of alders.

Lenzites betulina (*L.*) *Fr.*

Decaying wood of deciduous trees. Common.

Lenzites sepiaria *Fr.*

Dead and decaying wood of coniferous trees. Common.

Lenzites vialis *Pk.*

Decaying wood. Often on railroad ties and wooden bridges. Common.

Lenzites heteromorpha *Fr.*

Dead wood of spruce. Rare. Near Newman. September. Found but once. A very variable species, three of its forms representing the three genera Lenzites, Daedalea and Trametes and obliterating the artificial limitations assigned to them. The form found in North Elba is

referable to Daedalea but Fries has taken the form belonging to Lenzites as the type of the species.

Schizophyllum commune *Fr.*

Dead wood of deciduous trees and shrubs. Common.

RHODOSPORAE

Pluteus cervinus (*Schaeff.*) *Fr.*

Decaying wood in woods and clearings. Common.

Pluteus granularis *Pk.*

Woods. Prostrate trunks of trees. Near McKenzie pond. August. By a typographical error the name of this species was changed in Sylloge to *Pluteus regularis.*

Pluteus admirabilis *Pk.*

Prostrate trunks of trees in woods. Two forms occur, one having the pileus yellow, the other, brown.

Entoloma Grayanum *Pk.*

Ground in woods. Raybrook. August.

Entoloma strictius *Pk.*

Swamps and wet places. Wood farm. June.

Entoloma salmoneum *Pk.*

In woods and groves under spruce and balsam fir trees. Common and beautiful.

Entoloma cuspidatum *Pk.*

Damp ground and mossy places in woods and swamps. Remarkable for the cusp-like point in the center of the pileus.

Clitopilus Noveboracensis *Pk.*

Woods. Near Newman. September.

Clitopilus conissans *Pk.*

About the base of trees in woods. Rare. Near Adirondack lodge. August. A singular species not agreeing well with the character of the genus, but placed here because the color of the spores indicate such a position.

Clitopilus albogriseus *Pk.*

Woods. Near Adirondack lodge. August.

Leptonia serrulata *Pers.*

Shaded banks by roadside. Near upper iron bridge. It was collected in this place many years ago. I have not met with it recently.

Nolanea conica *Pk.*

Among mosses in woods and swamps, rarely on decaying wood. Common.

Claudopus nidulans (*Pers.*) *Pk.*

Decaying wood. Occasional. Valley of the Ausable. This is generally referred to the genus Pleurotus, but its spores have a beautiful pink color and for this reason it is placed here though it is not otherwise closely allied to this genus.

OCHROSPORAE

Pholiota caperata *Pers.*

Ground in woods and among mosses in swamps. Near Raybrook. August.

Pholiota aggerata *Pk.*

Banks by roadsides and on bare soil in thin woods. Adirondack lodge road. August.

Pholiota albocrenulata *Pk.*

At the base of standing trees of sugar maple, rarely on prostrate trunks of these trees. It is rare to find more than one or two specimens in a place.

Pholiota adiposa *Fr.*

FAT PHOLIOTA

Dead or decaying wood of deciduous trees. Lake Placid. Atkinson. Edible.

Pholiota lutea *Pk.*

Prostrate trunk of sugar maple. Near Wood's sap works. August. Found but once.

Pholiota flammans *Fr.*

Prostrate trunks of trees in woods. Near Lake Placid. Atkinson. Near Freemans Home. August. This is one of the prettiest species of the genus.

Pholiota acericola *Pk.*

Mossy prostrate trunks of sugar maple. Raybrook and Freemans Home. August.

Pholiota marginata *Batsch*

Dead wood in woods. Freemans Home. July.

Pholiota marginella *Pk.*

Decaying wood. Near South Meadow. June. Closely related to the preceding species from which it differs in its paler color and the even margin of the pileus.

Pholiota rugosa *Pk.*

Prostrate trunks in woods. Woods south of John Brown farm. August and September.

Pholiota confragosa *Fr.*

Prostrate trunks in woods. Near Connery pond. August.

Hebeloma firmum (*Pers.*) *Fr.*

Woods. Rare. Near Newman. September.

Inocybe calamistrata *Fr.*

Thin woods and along lumber roads. Common. August.

Inocybe infelix *Pk.*

Pastures and clearings. Common. June and July.

Inocybe subochracea *Pk.*

Thin woods and bushy places. Raybrook. August.

Inocybe rimosa (*Bull.*) *Fr.*

Woods, clearings and pastures. Common. August.

Inocybe albodisca *Pk.*

Groves of young coniferous trees. Woods east of Brewster farm. August.

Inocybe geophylla *Sow.*

Moist ground in woods. Common.

Inocybe Tricholoma (*A. & S.*) *Fr.*

Woods and groves. Not rare but generally only a few specimens occur in a place. August.

Flammula spumosa *Fr.*

Ground and decaying wood in woods and clearings. Common August and September.

Flammula Highlandensis *Pk.*

Damp ground, specially such as has been overrun by fire. Common. July and August.

Flammula viscida *Pk.*

Dead wood of alder. Old Keene road. August. Found but once. Allied to *F. alnicola* Fr., from which it may be separated by its viscid pileus, adnexed lamellae and densely cespitose mode of growth.

Flammula flavida *Pers.*

Dead and decaying wood. Common. August and September.

Naucoria semiorbicularis (*Bull.*) *Fr.*

Pastures and manured ground. Common. June and July.

Naucoria lignicola *Pk.*

Prostrate trunks of trees in woods. Outlet of Lake Placid and Freemans Home. June.

Naucoria scorpioides *Fr.*

Mossy ground in woods. Near Newman. Found but once.

Naucoria curvomarginata *Pk.*

Mossy ground under young coniferous trees. Near Newman. Found but once.

Galera tenera (*Schaeff.*) *Fr.*

Dung and manured ground in fields and pastures. Common. June to September.

Galera rufipes *Pk.*

Mossy ground in woods. Near Newman. September. Found but once.

Galera Hypnorum (*Batsch*) *Fr.*

Mossy ground and prostrate trunks in woods. Common.

Galera Sphagnorum (*Pers.*) *Fr.*

Among peat mosses in marshes. Common. June to August.

Tubaria deformata *Pk.*

Horse dung in lumber roads in woods. Connery pond. August. Found but once.

Crepidotus applanatus *Pers.*

Decaying wood. Raybrook. August.

Crepidotus epibryus *Fr.*

Mosses and fallen twigs and leaves of coniferous trees. Woods north of North Elba post office. August.

Crepidotus versutus *Pk.*

Dead wood and branches of balsam fir. Woods east of Brewster farm. August. *C. fulvotomentosus* Pk. is common on dead aspen in many parts of the Adirondacks and will probably be found here.

Cortinarius luteofuscus *Pk.*

Mossy ground in woods. Valley of the Ausable.

Cortinarius olivaceus *Pk.*

Mossy ground in deep woods. Slope of Mt Wright. August. This and the preceding species are closely allied to each other and to the European species *C. infractus* (Pers.) Fr. and *C. anfractus* Fr.

Cortinarius lanatipes *Pk.*

Groves of young coniferous trees. Near Newman. September.

Cortinarius fulgens (*A. & S.*) *Fr.*

Woods. Near the road to Epps farm. September. A showy species. Found but once.

Cortinarius violaceus (*L.*) *Fr.*

VIOLET CORTINARIUS

Damp woods. Valley of the Ausable. Edible. The young plant is dark violaceous in all its parts but in the mature plant the lamellae assume a rusty hue, being dusted by the spores.

Cortinarius canescens *Pk.*

Groves of young coniferous trees. Near Newman. September.

Cortinarius erraticus *Pk.*

With the preceding and somewhat resembling it.

Cortinarius cinnamomeus (*L.*) *Fr.*

CINNAMON CORTINARIUS

Woods, groves and bushy places. Common. Edible.

C. cinnamomeus semisanguineus *Fr.*

Woods. Raybrook. This is distinguished from the typical form by the color of the lamellae which in the young plant are dark red.

Cortinarius sanguineus (*Wulf.*) *Fr.*

Mossy ground in woods. Valley of the Ausable. August.

Cortinarius lutescens *Pk.*

Mossy places in woods. Near Newman. September.

Cortinarius armillatus (*A. & S.*) *Fr.*

Woods, commonly among fallen leaves. Easily known by the red bands on the stem.

Cortinarius adustus *Pk.*

Groves of young coniferous trees. Near Newman. September.

Cortinarius pallidus *Pk.*

Mossy ground in swampy woods. Near Newman. September.

Paxillus involutus (*Batsch*) *Fr.*

INVOLUTE PAXILLUS

Banks and woods among mosses or on bare ground. Common. Edible.

Paxillus rhodoxanthus (*Schw.*)

Thin woods. Rare. Raybrook. August. This species was placed by Schweinitz in the genus Gomphus (Gomphidius), but the color and the shape of the spores do not agree well with the characters of that genus. It is here placed in the genus Paxillus with which it agrees better in the color of its spores, but its lamellae do not anastomose behind. Perhaps it is a Flammula.

MELANOSPORAE

Agaricus silvaticus *Schaeff.*

Naked ground under spruce trees. Near North Elba postoffice. August.

Agaricus arvensis abruptus *Pk.*

Borders of woods. Raybrook. August. I have not seen the typical form of the species in North Elba, nor any examples of the common mushroom, *Agaricus campester* L.

Stropharia semiglobata (*Batsch*) *Fr.*

Dung and manured ground. Common.

Stropharia siccipes *Karst.*

Horse manure in lumber roads. Connery pond. August.

Hypholoma perplexum *Pk.*

PERPLEXING HYPHOLOMA

About stumps in clearings. Common. September. Edible.

Hypholoma incertum *Pk.*

UNCERTAIN HYPHOLOMA

Grassy places. Banks of the Ausable near Wood farm. Edible. June to August.

Psilocybe foenisecii (*Pers.*) *Fr.*

Grassy places. Valley of the Ausable. August.

Psathyra silvatica *Pk.*

Mossy ground in woods. Near Newman. September.

Coprinus stenocoleus *Lindbl.*

Manure piles. Wood farm. August.

Coprinus atramentarius silvestris *Pk.*

Woods. Lumber road between Raybrook and McKenzie pond. August. I have not seen the typical form of the species in North Elba.

Coprinus fimetarius (*L.*) *Fr.*

Manure heaps. Wood farm. August.

Coprinus micaceus (*Bull.*) *Fr.*

Decaying wood and roots of trees. Near Mountain View house August.

Coprinus plicatilis (*Curt.*) *Fr.*

Rich soil about barns. Raybrook. August.

Panaeolus campanulatus *L.*

Manure. Common. June to August.

Panaeolus solidipes *Pk.*

Manure. Epps farm. August.

POLYPORACEAE

Boletinus cavipes (*Opat.*) *Kalchb.*

Mossy ground under or near tamarack trees. Near Newman. August and September.

Boletinus pictus *Pk.*

PAINTED BOLETINUS

Thin woods and swamps, specially under pine trees. Raybrook and woods east of Brewster farm. August. Edible. A pretty species but it loses color in drying.

Boletinus paluster *Pk.*

Mossy marshes. Rare. Valley of the Ausable. August.

Boletus spectabilis *Pk.*

Swampy woods and marshes. Very rare. Valley of the Ausable. August. Found but once in North Elba, once in Hamilton county and once in Oswego county.

Boletus Elbensis *Pk.*

Under or near tamarck trees. July and August. Closely related to *B. laricinus* Berk.

Boletus Clintonianus *Pk.*

CLINTON'S BOLETUS

Mossy ground in thin woods, specially under or near tamarack trees. Near Newman. August and September. Edible.

Boletus subluteus *Pk.*

SMALL YELLOWISH BOLETUS

Under or near pine trees. Valley of the Ausable near Wood farm. August. Edible.

Boletus Americanus *Pk.*

With the preceding species and separable from it by the brighter yellow color of the pileus and the absence of a collar from the stem.

Boletus albus *Pk.*

Woods and groves, usually under or near pine or other coniferous trees. Raybrook and Indian pass trail. July and August. The type specimens were collected about 30 years ago a short distance north of Indian pass. Specimens were again collected in that locality the past season. The species is easily recognized by its white viscid pileus.

Boletus granulatus *L.*

GRANULATED BOLETUS

Pine woods and groves. Raybrook. August. Edible.

Boletus piperatus *Bull.*

Woods and clearings. Common. A small species having an acrid peppery taste.

Boletus Ravenelii *B. & C.*

Woods. Rare. Indian pass trail. August. The beautiful yellow tomentum of the pileus and stem makes this an attractive species but it has a very disagreeable acrid flavor.

Boletus auriporus *Pk.*

Thin woods. Near Newman. August.

Boletus subglabripes *Pk.*

SMOOTHISH STEM BOLETUS

Woods and groves. Raybrook. August. Edible.

Boletus chrysenteron *Fr.*

Woods and banks among mosses or on bare ground. Common and variable.

Boletus subtomentosus *L.*

Woods. Raybrook and Newman farm. August.

Boletus illudens *Pk.*

Woods and bushy places. Newman farm and woods east of Brewster farm. August.

Boletus ornatipes *Pk.*

Thin woods and banks by roadsides. Raybrook and Mountain View house. August.

Boletus edulis *Bull.*

EDIBLE BOLETUS

Thin woods and banks. Valley of the Ausable. Edible.

Boletus affinis maculosus *Pk.*

RELATED BOLETUS

Woods. Common. August. Edible. The typical form was not seen in North Elba.

Boletus luridus *Schaeff.*

Thin woods and groves. Newman farm. August.

Boletus subvelutipes *Pk.*

Woods east of Brewster farm. August.

Boletus versipellis *Fr.*

ORANGE CAP BOLETUS

Thin woods and groves. Raybrook. August. Edible.

Boletus scaber *Fr.*

ROUGH STEM BOLETUS

Woods and clearings. Common. Edible.

Boletus nebulosus *Pk.*

Banks and groves. Rare. Raybrook and Newman farm. August.

Boletus chromapes *Frost*

Thin woods. Rare. Indian pass trail. August.

Boletus felleus *Bull.*

Woods and groves. Raybrook. It has a persistent bitter flavor which is suggestive of the specific name.

Boletus gracilis *Pk.*

Woods. Indian pass trail. August.

Boletus cyanescens *Bull.*

Woods and banks. Common. August.

Polyporus Schweinitzii *Fr.*

Woods and groves about stumps of pine trees. Raybrook. This sometimes appears to grow from the ground, but in such cases it probably starts from some buried wood or root in which the mycelium develops.

Polyporus hispidellus *Pk.*

Thin woods. Very rare. Wood farm. August. Like the preceding species this appears to grow from buried wood or roots.

Polyporus picipes *Fr.*

Decaying wood. Common and variable in size, shape and color.

Polyporus elegans (*Bull.*) *Fr.*

Dead or decaying wood. Variable. The stem may be long or short, central, eccentric or lateral. The pileus varies from half an inch to two inches or more in diameter.

Polyporus Anax *Berk.*

Mossy ground in thin woods. Near Newman. September.

Polyporus sulphureus (*Bull.*) *Fr.*

SULPHURY POLYPORUS

Decaying wood. Near Averyville. July. A beautiful species easily recognized by its orange colored pileus and bright sulphur yellow pores. When young and tender it is edible.

Polyporus guttulatus *Pk.*

Decaying wood of coniferous trees. Indian pass trail.

Polyporus chioneus *Fr.*

Dead wood and branches, specially of birch. Common.

Polyporus adustus (*Willd.*) *Fr.*

On old stumps and dead or prostrate trunks. Very common. Easily known by the dingy hue of the pileus and the black color of the pores.

Polyporus Weinmanni *Fr.*

Decaying wood of coniferous trees. Common. Easily known by its strigose pileus and the reddish stains assumed where it is cut or bruised.

Polyporus borealis (*Wahl.*) *Fr.*

Dead or decaying wood of coniferous trees, specially of spruce Common.

Polyporus benzoinus (*Wahl.*) *Fr.*

Decaying wood of coniferous trees. Vicinity of Lake Placid Atkinson.

Polyporus pubescens (*Schum.*) *Fr.*

Dead wood of deciduous trees and shrubs. Common.

Fomes pinicola *Fr.*

Dead or decaying wood of coniferous trees. Very common and varying much in the color of the pileus.

Fomes fomentarius (*L.*) *Fr.*

Dead trunks of deciduous trees, standing or prostrate. Common.

Fomes applanatus (*Pers.*) *Wallr.*

Dead trunks of deciduous trees. Common. The pileus is generally broader and more flattened than in the preceding species. Its upper surface is often dusted by the ferruginous colored spores even when there is no source above from which they could have fallen.

Fomes igniarius (*L.*) *Fr.*

Dead places in standing trunks of deciduous trees. It is rare to find more than one or two specimens on a single trunk.

Fomes salicinus (*Pers.*) *Fr.*

Trunks of yellow birch trees either prostrate or standing. In the latter case the fungus is usually near the base.

Fomes connatus *Fr.*

Trunks and stumps of maple trees. Occasional. The upper surface of the pileus is often overrun by mosses whose green color contrasts strongly with the white color of the fungus.

Fomes carneus *Nees*

Dead or decaying wood of spruce. Common. The color of the young pileus is similar to that of the pores, but it becomes darker and brownish or even blackish with age. A rare form occurs in which the pileus is zonate.

Polystictus circinatus *Fr.*

Mossy ground and specially in groves of young coniferous trees. It is remarkable for the difference in texture between the upper stratum of the pileus and the lower.

Polystictus perennis (*L.*) *Fr.*

Thin woods and clearings and banks by roadsides. Common. A beautiful species when fresh and well grown, but the pileus fades with age.

Polystictus hirsutus (*Wulf.*) *Fr.*

Dead wood of deciduous trees. Common and variable.

Polystictus versicolor (*L.*) *Fr.*

Dead wood of trees and shrubs. Very common and also very variable. Often growing on stumps and forming large imbricated masses.

Polystictus pergamenus *Fr.*

Dead wood of deciduous trees, specially of aspen. Common.

Polystictus abietinus (*Dicks.*) *Fr.*

Dead trunks and branches of coniferous trees. Very common. Bearing some resemblance to the preceding species and like it having the pores more or less violaceous.

P. abietinus irpiciformis *Pk.*

Dead trunks of balsam fir. Near Averyville. September.

Poria vaporaria *Fr.*

Dead wood and bark. Near Newman. September.

Poria marginella *Pk.*

Prostrate trunks of spruce. Near Newman. Found but once.

Poria inermis *E. & E.*

Dead trunks of deciduous trees and shrubs. Common.

Poria rhodella *Fr.*

Prostrate trunks of coniferous trees. Near Newman.

Poria subacida *Pk.*

Decaying wood of deciduous and coniferous trees. Common. A variable species.

Trametes cinnabarina (*Jacq.*) *Fr.*

This beautiful species commonly grows on birch, cherry and other deciduous trees but occasionally it occurs on hemlock. Not rare. It is sometimes placed in the genus Polystictus.

Trametes Sepium *Berk.*

Dead wood and bark of spruce. Indian pass.

Trametes serialis *Fr.*

Prostrate trunks of spruce. Indian pass.

T. serialis resupinata *Romell*

Prostrate trunks of spruce. Freemans Home.

Trametes Abietis *Karst.*

Dead trunks of spruce. Common.

Trametes variiformis *Pk.*

Dead trunks of spruce. Raybrook. Formerly referred to the genus Polyporus.

Daedalea confragosa (*Bolt.*) *Pers.*

Dead trunks of deciduous trees and shrubs, specially of birch, alder and willow. Valley of the Ausable. This species as here understood includes forms having the characters of Lenzites and Trametes as well as of Daedalea. Its variation is similar to that of *Lenzites heteromorpha* Fr.

Daedalea unicolor (*Bull.*) *Fr.*

Dead and decaying wood. Common.

Favolus Canadensis *Klotzsch*

Dead branches of beech. Valley of the Ausable. August.

Merulius aureus *Fr.*

Dead trunks of balsam fir. Raybrook and Newman. August and September.

Merulius molluscus *Fr.*

Dead wood and bark of spruce. Averyville. September.

Merulius fugax *Fr.*

Decaying wood. Wood farm. August.

Solenia filicina *Pk.*

Dead fern stems. Near Lake Placid. Atkinson.

HYDNACEAE

Hydnum repandum *L.*

SPREADING HYDNUM

Ground in woods and clearings. Raybrook. August. Edible.

Hydnum zonatum *Batsch*

Ground in woods or bushy places. Raybrook. August.

Hydnum septentrionale *Fr.*

Dead wood of sugar maple. Raybrook. August.

Hydnum ochraceum *Pers.*

Dead or decaying wood. Near Lake Placid. Atkinson. Raybrook. August.

Hydnum coralloides *Scop.*

CORAL-LIKE HYDNUM

Prostrate trunks of trees in woods. Near Lake Placid. Atkinson. Raybrook. August. Edible.

Hydnum viride (*A. & S.*) *Fr.*

Decaying wood. Indian pass trail. August.

Hydnum farinaceum *Pers.*

Dead wood of spruce and balsam fir. Wood farm. August.

Astrodon setiger *Pk.*

Decaying wood of coniferous trees. Indian pass trail. August. Easily confused with *Caldesiella ferruginosa* (Fr.) Sacc.

Tremellodon gelatinosum (*Scop.*) *Pers.*

Decaying wood of coniferous trees. Wood farm. August. Some authors refer this species to the family Tremellaceae.

Irpex lacteus *Fr.*

Dead trunks and branches of deciduous trees. Common.

Irpex ambiguus *Pk.*

Dead wood and bark of beech. Raybrook. August.

Phlebia vaga *Fr.*

Dead trunks of coniferous trees. Near Newman. September.

THELEPHORACEAE

Craterellus cornucopioides (*L.*) *Pers.*

CORNUCOPIA CRATERELLUS

Ground in woods and lumber roads. Raybrook. August. Edible.

Thelephora Schweinitzii *Pk.*

Ground in woods and clearings. Raybrook. August.

Thelephora laciniata *Pers.*

Woods and swamps. Often growing from the base of small shrubs. Raybrook. August.

Stereum fasciatum *Schw.*

Dead wood and prostrate trunks. Common. August. Intermediate forms appear to unite this with *S. versicolor* Fr.

Stereum hirsutum (*Willd.*) *Fr.*

Dead wood of deciduous trees. Wood's sap works. August.

Stereum balsameum *Pk.*

Dead trunks of balsam fir. Indian pass. August.

Stereum rugosum *Fr.*

Dead wood in woods. Common.

Stereum populneum *Pk.*

Prostrate trunks of aspen. Raybrook. August. The singular *S. ambiguum* Pk. was found on prostrate trunks of spruce at Cascade lake, only a short distance from the east line of the town and it will probably yet be found in North Elba.

Hymenochaete tabacina (*Sow.*) *Lev.*

Dead trunks and branches, specially of the mountain maple.

Hymenochaete corrugata (*Fr.*) *Lev.*

Dead trunks and branches of deciduons trees. Near Lake Placid. Atkinson. Near Adirondack lodge.

Corticium amorphum (*Pers.*) *Fr.*

Dead bark of balsam fir. Northern entrance to Indian pass.

Corticium sulphureum *Fr.*

Prostrate trunks of balsam fir. Woods near the road to Epps farm. September.

Corticium subincarnatum *Pk.*

Decorticated wood of spruce. Near Newman. September.

Corticium viticolum *Schw.*

Dead trunks and branches of mountain maple. Adirondack lodge. August.

CLAVARIACEAE

Clavaria cristata *Pers.*

CRESTED CLAVARIA

Low woods and under young coniferous trees. Brewster farm. August. Edible.

Clavaria circinans *Pk.*

Groves of young coniferous trees. Near North Elba post office. August.

Clavaria rugosa *Bull.*

Damp ground in woods or clearings. Raybrook. August.

Clavaria flaccida *Fr.*

Woods and under coniferous trees. Common. August.

Clavaria pusilla *Pk.*

Under spruce and balsam fir trees. Near North Elba post office and Newman farm. August.

Clavaria stricta *Pers.*

Decaying wood and prostrate trunks in woods. Common.

Clavaria platyclada *Pk.*

Woods. Moose island. September.

Clavaria inaequalis *Mull.*

Woods near Clear lake. August.

Clavaria Ligula *Fr.*

Woods. Generally under coniferous trees. Common.

Clavaria vernalis *Schw.*

Banks by roadsides. Road to Epps farm. June.

Clavaria juncea *Fr.*

Among fallen leaves. Near Newman. September.

Calocera cornea *Fr.*

Decaying wood. Near North Elba post office. August.

Typhula muscicola (*Pers.*) *Fr.*

Mosses. Epps farm. August.

Physalacria inflata (*Schw.*) *Pk.*

Decaying wood. Common. August and September.

TREMELLACEAE

Hirneola Auricula-Judae (*L.*) *Berk.*

Dead wood of spruce and balsam fir. Common. July and August.

Tremella lutescens *Pers.*

Dead trunks and branches of beech. Near Mountain View house. August.

Tremella mycetophila *Pk.*

Pileus and stem of *Collybia dryophila* Bull. Near Brewster farm.

Nematelia encephala (*Willd.*) *Fr.*

Trunks of balsam fir. Indian pass. August.

GASTEROMYCETEAE

LYCOPERDACEAE

Bovista pila *B. & C.*

Pastures and grassy places. Raybrook and Wood farm.

Bovista plumbea *Pers.*

Pastures. Raybrook and Wood farm. August.

Lycoperdon gemmatum *Batsch*

Ground and decaying wood in woods and clearings. August.

Lycoperdon pyriforme *Schaeff.*

Habitat same as the last. Common.

Lycoperdon subincarnatum *Pk.*

Decaying wood and old logs in woods. Common. July and August.

Lycoperdon separans *Pk.*

Grassy or bushy places. Raybrook. August.

Lycoperdon furfuraceum *Schaeff*

Ground in pastures. Raybrook. August.

Scleroderma vulgare *Fr.*

Ground and much decayed wood in woods and clearings. Common. August.

HYPODERMEAE

USTILAGINACEAE

Ustilago Avenae (*Pers.*) *Jens.*

Oat fields. Wood farm. August. This fungus is parasitic on oats. It lives in the oat plant till the panicles appear. Then the fungus makes its presence known by developing its own dusty sooty black mass of spores in the panicles where the grain or seed of the oats should appear. It is an injurious fungus as it destroys many bushels of oats annually. Its ravages however can easily be prevented by treating the seed oats by the hot water process. This is simply soaking the seed about 10 minutes in water kept at a temperature of 132 or 133 degrees F. The fungus is commonly known as oat smut.

UREDINACEAE

Uromyces Caladii (*Schw.*) *Farl.*

Living leaves of Indian turnip. Indian pass trail. June. Only the aecidial form was found.

Puccinia Prenanthis (*Pers*) *Fckl.*

Living leaves of rattlesnake root, *Nabalus albus.* Wallface mountain and Indian pass. June. Only the aecidial form was found.

Puccinia Violae (*Schum.*) *DC.*

Living leaves of violets. Freemans Home. June. Only the aecidial form was found.

Puccinia pulchella *Pk.*

Living leaves of fetid currant. Valley of the Ausable. Near the Notch house.

Puccinia Claytoniata (*Schw.*)

Living leaves of Carolina spring beauty. Old Keene road. June. This is *Puccinia Mariae-Wilsoni* Clinton. The aecidial form was described by Schweinitz under the name *AEcidium claytoniatum.*

Puccinia Asteris *Duby.*

Living leaves and generally the basal ones only of the large leaved aster, *A macrophyllus.* Wood farm. August.

P. Asteris purpurascens *C. & P.*

Living leaves of mountain aster, *A. acuminatus.* Indian pass. August.

Puccinia Circaeae *Pers.*

Living leaves of small enchanter's nightshade, *Circaea alpina*. Northern entrance to Indian pass. August.

Puccinia Tiarellae *B. & C.*

Living leaves of false mitrewort, *Tiarella cordifolia*. Wood farm. August. This is thought by some to be the same as *P. Heucherae* Schw.

Puccinia porphyrogenita *Curt.*

Living leaves of dwarf cornel, *Cornus Canadensis*. Woods east of Brewster farm. August.

Puccinia mesomegala *B. & C.*

Living leaves of northern clintonia, *Clintonia borealis*. Old Keene road. June and July

Triphragmium clavellosum *Berk.*

Living leaves of wild sarsaparilla, *Aralia nudicaulis*. Ausable valley. August.

Peridermium balsameum *Pk.*

Living leaves of balsam fir. Woods east of Brewster farm. August. This parasitic fungus discolors the affected leaves but they attain their usual size.

Peridermium elatinum (*A. & S.*) *K. & S.*

Living leaves of balsam fir. July. This fungus affects both branches and leaves. It causes an abnormal development of the branch attacked, increasing greatly the number of shoots and making a dense cluster commonly known as *crow's nest*. All the leaves on an affected branch show the presence of the fungus and attain only about half their usual size. Generally the attack is limited on a tree to a single branch and its branchlets, but the fungus is perennial and persists till the branch dies.

Peridermium decolorans *Pk.*

Living leaves of spruce trees. Top of Mt McIntyre. July and August. This was made a variety of *P. abietinum* A. & S. by Thumen, but I see no good reason for so doing.

Peridermium Engelmanni *Thum.*

On spruce cone scales. Rare. In thin woods southwest of North Elba post office. August. Only a few cones on a tree were affected.

Caeoma nitens *Schw.*

Living leaves of dewberry, *Rubus Canadensis.* Common. June. This parasitic fungus also attacks leaves of the blackberry and sometimes proves to be a great pest to the cultivator of these fruits.

PYRENOMYCETEAE

PERISPORIACEAE

Dimerosporium Collinsii (*Schw.*) *Thum.*

Living leaves of Juneberry. Raybrook. A parasitic fungus which attacks the leaves, blackens them and causes their death. It also sometimes distorts the branches. It covers the lower surface of the leaf with its perithecia.

SPHAERIACEAE

Diatrype Stigma (*Hoffm.*) *Fr.*

Dead wood of deciduous trees. Common.

Xylaria corniformis *Fr.*

Decaying wood in woods. Raybrook. August and September.

Xylaria castorea *Berk.*

Decaying wood of sugar maple. Near Mountain View house.

Xylaria digitata (*L.*) *Grev.*

Prostrate trunks of deciduous trees. Wood's sap works. September.

Ustulina vulgaris *Tul.*

Decaying wood of deciduous trees. Common.

Hypoxylon fuscum (*Pers.*) *Fr.*

Dead trunks and branches of deciduous trees and shrubs, specially of alder. Common.

Hypoxylon cohaerens (*Pers.*) *Fr.*

Dead trunks and branches of beech. Common.

Hypoxylon Morsei *B. & C.*

Dead trunks and branches of alder. Valley of the Ausable.

Hypoxylon perforatum *Schw.*

Dead trunks of mountain maple. South Meadow.

Hypoxylon multiforme *Fr.*

Dead wood of yellow birch. Old Keene road.

Daldinia vernicosa (*Schw.*) *C. & D.*

Dead trunks of young standing deciduous trees. John Brown farm. It is very doubtful if this and *D. concentrica* (Bolt.) C. & D. are really distinct species. Connecting forms seem to occur.

Nummularia repanda (*Fr.*) *Nits.*

Dead trunks of American mountain ash. Near Newman. September.

HYPOCREACEAE

Hypomyces lateritius (*Fr*) *Tul.*

On the hymenium of *Lactarius uvidus.* Valley of the Ausable.

Hypocrea rufa (*Pers.*) *Fr.*

Decaying wood of sugar maple. Raybrook. August.

Nectria cinnabarina (*Tode*) *Fr.*

Dead branches of deciduous trees. Valley of the Ausable. The conidial state, *Tubercularia vulgaris* Tode, grows in company with it.

Chilonectria Rosellinii (*Carest.*) *Sacc.*

Dead bark of balsam fir. Valley of the Ausable.

Claviceps purpurea (*Fr.*) *Tul.*

ERGOT. SPURRED RYE

Heads of rye. Wood farm. August. The affected grains become much enlarged, elongated and changed in color and texture.

DOTHIDEACEAE

Plowrightia morbosa (*Schw.*) *Sacc.*

Living branches of wild red cherry. Lake Placid. Freemans Home and Indian pass. This is a destructive parasitic fungus which produces unsightly black swellings or excresences on the branches. These swell-

ings are commonly known as *black knot*. The disease soon kills the attacked branches and generally it continues its work till it kills the tree. The spores of the fungus may spread from the wild cherry trees to cultivated cherry and plum trees and produce the disease in them.

HYSTERIACEAE

Dichaena faginea (*Pers.*) *Fr.*

Bark of living beech trees. Very common.

Hypoderma nervisequum (*DC.*) *Fr.*

Living leaves of balsam fir. Woods east of Brewster farm.

DISCOMYCETEAE

HELVELLACEAE

Gyromitra sphaerospora (*Pk.*) *Sacc.*

Decaying wood. Very rare. Adirondack lodge road and Indian pass trail. June and July. Not yet known to occur out of this state.

Gyromitra esculenta crispa *Pk.*

Groves of young coniferous trees. East of Brewster farm. June. The typical form usually occurs in pine groves or under or near pine trees. It was not seen in North Elba.

Helvella Infula *Schaeff.*

Decaying wood and ground in woods. Near Connery pond and Averyville.

Mitrula phalloides (*Bull.*) *Chev.*

Decaying leaves and other vegetable matter lying in water. Indian pass trail and woods southeast of Wood farm.

Mitrula vitellina irregularis (*Pk.*) *Sacc.*

IRREGULAR MITRULA

Damp mossy ground in woods. Near Newman. September. Edible. This differs from the European *M. vitellina* (Bres.) Sacc. in its much more irregular clubs of which it is scarcely possible to find two alike.

Leptoglossum luteum (*Pk.*) *Sacc.*

Mossy ground and much decayed wood. Raybrook and near Clear lake. August.

Spathularia clavata *(Schaeff.) Sacc.*

Among fallen leaves or on mossy ground. Common.

Spathularia rugosa *Pk.*

Under young coniferous trees. East of Brewster farm. August. It sometimes grows in arcs of circles.

Spathularia velutipes *C. & F.*

Ground and decaying wood in woods. Near Clear lake.

Cudonia circinans *(Pers.) Fr.*

Bare or mossy ground. Woods east of Brewster farm.

Cudonia lutea *(Pk.) Sacc.*

Prostrate mossy trunks of trees in woods. Near Newman.

Vibrissea Truncorum *(A. & S.) Fr.*

Decaying sticks and wood lying in water. Old Keene road and northern entrance to Indian pass. August.

V. Truncorum albipes *Pk.*

Decaying sticks and logs in quiet water. Clear lake. The variety differs from the type in having a whitish stem.

PEZIZACEAE

Rhizina inflata *(Schaeff.) Quel.*

Ground where fire has been. Valley of the Ausable. August.

Geopyxis vulcanalis *(Pk.) Sacc.*

Ground where fire has been. Wood farm. August.

Peziza badia *Pers.*

Ground in woods. Near Averyville. June.

Peziza odorata *Pk.*

Ground overrun by fire. Brewster farm. June.

Peziza vesiculosa *Bull.*

Manure about the barn of a lumber camp in woods east of Freemans Home. June.

Lachnea scutellata *(L.) Sow.*

Decaying wood in damp places. Common and beautiful.

Lachnea stercorea *(Pers.) Fr.*

Cow manure. Valley of the Ausable. August.

Lachnea scubalonta *(C. & G.) Sacc.*

Cow manure. Near Newman. September.

Helotium citrinum *(Hedw.) Fr.*

Decaying wood in woods and clearings. Common.

Mollisia cinerea *(Batsch) Karst.*

Damp decaying wood. Common.

Pezicula acericola *Pk.*

Trunks and branches of mountain maple. Valley of the Ausable August.

Chlorosplenium aeruginosum *(OEder) DeN.*

Decaying wood. Near Lake Placid. Mrs E. G. Britton.

Chlorosplenium aeruginascens *(Nyl.) Karst.*

Similar to the last in size, color and habitat. Near Lake Placid Mrs Britton.

Dasyscypha Agassizii *(B. & C.) Sacc.*

Trunks and branches of balsam fir. Very common.

DERMATEACEAE

Tympanis conspersa *Fr.*

Dead trunks of alder. H. Brown farm. June.

Tympanis alnea *(Pers.) Fr.*

Dead trunks of alder. Old Keene road. June.

Tympanis laricina *(Fckl.) Sacc.*

Dead trunks and branches of tamarack and balsam fir. Near Newman and Indian pass trail. August and September.

BULGARIACEAE

Leotia lubrica (*Scop.*) *Pers.*

Mossy ground in woods. Valley of the Ausable.

Ombrophila albiceps *Pk.*

Decaying wood of deciduous trees. Near Newman. September.

PHACIDIACEAE

Celidium Stictarum (*DeN.*) *Tul.*

Apothecia of lungwort lichen, *Stictis pulmonaria.* Woods near Wood farm. The parasite blackens the disk of the apothecium.

GYMNOASCACEAE

Exoascus confusus *Atk.*

Fruit of choke cherry. Freemans Home. June. The fungus deforms the fruit and floral organs and prevents their proper development.

Exoascus unilateralis *Pk.*

Living leaves of choke cherry. Roadside between North Elba post office and Wood farm. June.

Exoascus Insititiae *Sadeb.*

Living leaves of wild red cherry. Newman and Freemans Home. June.

MYXOMYCETEAE

PHYSARACEAE

Fuligo septica (*Lk.*) *Gmel.*

Various substances and variable in external color.

Craterium leucocephalum (*Pers.*) *Rost.*

Fallen leaves and other decaying vegetable matter. Near Newman.

Tilmadoche nutans (*Pers.*) *Rost.*

Prostrate trunks of trees and other substances. Wood farm.

DIDYMIACEAE

Didymium flavidum *Pk.*

Bark of dead balsam fir. Valley of the Ausable.

Didymium farinaceum *Schrad.*

Various substances. Valley of the Ausable.

Didymium eximium *Pk.*

Fallen leaves and other substances. Adirondack lodge. G. A. Rex.

STEMONITACEAE

Stemonitis ferruginea *Ehrh.*

Decaying wood in woods. Raybrook.

RETICULARIACEAE

Reticularia Lycoperdon *Bull.*

Decaying wood. Valley of the Ausable.

Siphoptychium Casparyi *Rost.*

Decaying wood. Lake Placid. Dr Rex.

ARCYRIACEAE

Arcyria punicea *Pers.*

Decaying vegetable matter. Raybrook.

Lycogala epidendrum *Buxb.*

Damp decaying wood. Common. The little globes have a beautiful pinkish red color when young and pulpy, but they become grayish brown with maturity.

Lycogala flavofuscum *Ehrenb.*

Trunks of trees. Wood farm. Much larger than the last.

TRICHIACEAE

Hemiarcyria clavata (*Pers.*) *Rost.*

Decaying wood and prostrate trunks. Common.

SPHAEROPSIDEAE

SPHAERIOIDACEAE

Phyllosticta limitata *Pk.*

Living leaves of apple. Near Mountain View house. August. This parasitic fungus produces small reddish brown orbicular spots on the leaves.

Septoria acerina *Pk.*

Living leaves of striped maple. Common. June and July.

Septoria Saccharini *E. & E.*

Living leaves of sugar maple. Common. August.

LEPTOSTROMACEAE

Leptothyrium Periclymeni (*Desm.*) *Sacc.*

Living leaves of American fly honeysuckle. Wood farm.

HYPHOMYCETEAE

MUCEDINACEAE

Oidium destruens *Pk.*

Living leaves of black cherry. Freemans Home. June. A parasitic fungus that is very destructive to the leaves it attacks.

Ramularia Tulasnei *Sacc.*

Living leaves of strawberry. Common. June to August. This fungus is a pest to cultivators of the strawberry. It produces white purplish-margined spots on the leaves and destroys the vigor of the plant.

DEMATIACEAE

Cercospora Caulophylli *Pk.*

Living leaves of blue cohosh. Wood's sap works. August.

Cercospora caricina *E. & D.*

Living leaves of drooping wood sedge, *Carex arctata.* Little Cherry-patch pond. August.

STILBACEAE

Sporocybe sphaerophila (*Pk.*) *Sacc.*

Parasitic on black knot of wild red cherry. Head of Cascade lake and Indian pass. July.

Isariopsis alborosella (*Desm.*) *Sacc.*

Parasitic on mouse ear chickweed. Freemans Home. June.

SUMMARY

SEED-BEARING PLANTS

Spermatophyta	Species
Ranunculaceae	17
Berberidaceae	1
Nymphaeaceae	3
Sarraceniaceae	1
Fumariaceae	3
Cruciferae	14
Violaceae	8
Caryophyllaceae	8
Portulacaceae	2
Hypericaceae	4
Malvaceae	1
Tiliaceae	1
Geraniaceae	4
Ilicineae	1
Sapindaceae	4
Leguminosae	7
Rosaceae	38
Saxifragaceae	10
Crassulaceae	1
Droseraceae	1
Halorageae	3
Onagraceae	8
Cucurbitaceae	1
Umbelliferae	7
Araliaceae	2
Cornaceae	3
Caprifoliaceae	9
Rubiaceae	6
Compositae	46
Lobeliaceae	1
Campanulaceae	3
Ericaceae	19
Diapensiaceae	1

Spermatophyta—*Continued*	Species
Primulaceae	2
Oleaceae	2
Apocynaceae	1
Asclepiadaceae	1
Gentianaceae	1
Hydrophyllaceae	1
Convolvulaceae	1
Scrophulariaceae	6
Lentibulaceae	2
Labiatae	11
Plantaginaceae	2
Amaranthaceae	1
Chenopodiaceae	1
Polygonaceae	12
Thymeleaceae	1
Loranthaceae	1
Euphorbiaceae	1
Urticaceae	4
Myricaceae	2
Cupuliferae	7
Salicaceae	10
Empetraceae	1
Coniferae	11
Orchidaceae	12
Iridaceae	2
Liliaceae	13
Juncaceae	9
Typhaceae	3
Araceae	2
Alismaceae	1
Naiadaceae	7
Eriocauleae	1
Cyperaceae	50
Gramineae	40

SPORE-BEARING PLANTS

Pteridophyta	
Equisetaceae	3
Lycopodiaceae	6
Filices	19
Ophioglossaceae	3
Selaginellaceae	1

Bryophyta	
Sphagnaceae	10
Andreaeaceae	1
Bryaceae	138
Jungermanniaceae	35
Marchantiaceae	1

Thallophyta	Species
Usneaceae	11
Parmeliaceae	17
Umbilicariaceae	3
Peltigeraceae	12
Pannariaceae	2
Collemaceae	5
Lecanoraceae	13
Cladoniaceae	14
Lecideaceae	14
Opegraphaceae	1
Agaricaceae	234
Polyporaceae	72
Hydnaceae	12
Thelephoraceae	14
Clavariaceae	14
Tremellaceae	4
Lycoperdaceae	8
Ustilaginaceae	1
Uredinaceae	16
Perisporiaceae	1
Sphaeriaceae	12

Thallophyta—*Continued*	Species
Hypocreaceae	5
Dothideaceae	1
Hysteriaceae	2
Helvellaceae	12
Pezizaceae	14
Dermateaceae	3
Bulgariaceae	2
Phacidiaceae	1
Gymnoascaceae	3
Physaraceae	3
Didymiaceae	3
Stemonitaceae	1
Reticulariaceae	2
Arcyriaceae	3
Trichiaceae	1
Sphaerioidaceae	3
Leptostromaceae	1
Mucedinaceae	2
Dematiaceae	2
Stilbaceae	2

Seed-bearing plants	**Spermatophyta**						460
Spore-bearing plants	**Pteridophyta**	**Ferns**		19	32		763
		Fern allies		13			
	Bryophyta	**Mosses**		149	185		
		Liverworts		36			
	Thallophyta	**Lichens**		92	546		
		Fungi	**Hymenomyceteae**	350	454		
			Gasteromyceteae	8			
			Hypodermeae	17			
			Pyrenomyceteae	21			
			Discomyceteae	35			
			Myxomyceteae	13			
			Sphaeropsideae	4			
			Hyphomyceteae	6			

Number of families represented 118, number of species 1223

INDEX

Names of the species are those of Britton and Brown's *Illustrated flora*. Names in italics are synonyms mostly used in Gray's *Manual*. The superior figures tell the exact place on the page in ninths; e. g. 85^3 means page 85, beginning in the third ninth of the page, i. e. about one third of the way down.

(Pages 267–8 were bulletin cover pages)

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BULLETIN

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FREDERICK J. H. MERRILL, *Director*

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PRELIMINARY LIST

OF THE

MAMMALS OF NEW YORK

BY

GERRIT S. MILLER JR

ALBANY

UNIVERSITY OF THE STATE OF NEW YORK

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CONTENTS

Note by the Director

The long period of time which has elapsed since the publication of De Kay's report on the zoology of New York in 1842 and the great progress of systematic zoology during that interval have made it important for the New York state museum to issue a systematic description of the New York mammals at present known. In seeking for some one properly equipped to prepare this important contribution, the director was brought, through the courtesy of Dr C. Hart Merriam, into communication with Gerrit S. Miller jr, who has undertaken and completed the work.

As the editing rules in bibliography, adopted by the Regents of the University of the State of New York, are materially different from those which Mr Miller is in the habit of following, he has asked to be relieved of all responsibility for any errors that might be introduced in the editorial revision of this part of the work. The director takes pleasure in relieving Mr Miller from this responsibility, though he believes that sufficient care has been taken to make the work entirely reliable.

Frederick J. H. Merrill, *Director*

1 Volume and page numbers are separated by a colon; e. g. 3 : 150 means volume 3, page 150.

Preliminary list of the Mammals of New York

INTRODUCTION

At the suggestion of Dr Frederick J. H. Merrill, director of the New York state museum, I have prepared the following preliminary list of the mammals of New York. To write a preliminary paper on this subject 14 years after the appearance of Dr C. Hart Merriam's two volumes on the mammals of the Adirondack region, and 56 years after the publication of De Kay's elaborate work on the mammals of the state at large, may at first seem paradoxical. Nevertheless one of the most important results of the recent great increase in our knowledge of the mammalian fauna of New York is the realization that nothing more than preliminary work can be done now. The whole area of the state must receive a thorough biologic survey before final results can be expected. To aid in preparing the way for such a final investigation is the main purpose of this paper. My aim is to bring together the scattered published knowledge of the subject rather than to add any considerable mass of new facts.

HISTORY OF THE LIST OF NEW YORK MAMMALS

The first important work on the mammals of New York was published by DeKay in 1842 as part one of the *Zoology of New York.*[1] In this work 70 mammals are recorded as forming part of the natural fauna of the state. Seven of these, *Didelphis virginiana*, opossum, *Sorex parvus* (=*Blarina parva*), small shrew, *Sorex carolinensis* (=*Blarina brevicauda carolinensis*), short-tailed shrew, *Arvicola xanthognathus* (=*Microtus xanthognathus*), yellow-cheeked meadow mouse, *Rangifer tarandus* (=*Rangifer caribou*), caribou, *Rorqualus borealis* (=*Sibbaldius borealis*) silver-bottom whale, and *Delphinus delphis*, porpoise, are included without definite knowledge of their occurrence within the boundaries of the state. Eight others, *Sorex dekayi* (=*Blarina brevicauda*, short-tailed shrew), *Otisorex platyrhinus* (=*Sorex personatus*, masked shrew), *Mustela fusca* (=*Putorius richardsoni cicognani*, Bonaparte's weasel), *Sciurus niger* (=black phase of *S. carolinensis leucotis*, northern gray squirrel), *Mus americanus* (=*M. rattus*, black rat), *Arvicola hirsutus* (=*Microtus penn-*

[1] For full title see bibliography, p. 379.

sylvanicus, meadow mouse), *Arvicola oneida* (=*Microtus pennsylvanicus*, meadow mouse), and *A. alborufescens* (=*Evotomys gapperi*, common red-backed mouse), prove to have been founded on insufficient characters. One species (*Microtus pinetorum scalopsoides*, northern pine mouse) described by Audubon and Bachman in 1841 from specimens taken on Long Island, De Kay omits. Therefore the total number of known New York mammals in 1842 was 56.

During the 40 years immediately following the publication of De Kay's work, the list of New York mammals received only three additions: *Neotoma pennsylvanica*, cave rat, recorded by Baird in 1857 under the specific name *floridana*, *Parascalops breweri*, hairy-tailed mole, recorded by Baird in 1865 under the name *Scalops breweri* and *Myotis subulatus*, Say's bat, recorded by H. Allen in 1863, and for the first time distinguished from *M. lucifugus*, little brown bat (=the *Vespertilio subulatus* of De Kay). It is possible that the supposed occurrence of the opossum was confirmed during this period; but I have been unable to determine when the first definite record of this animal as an inhabitant of New York was published. Most of the eliminations to which I have referred were, however, made during this period by Baird, Coues and J. A. Allen. From 1842 to 1882 there appeared no important paper dealing specially with the mammals of New York, a clear indication that the stability of the list during this time resulted from lack of interest in the subject rather than from fulness of knowledge.

After De Kay, the first writer to deal extensively with the mammals of New York was Dr C. Hart Merriam, who issued two volumes on the mammals of the Adirondack region in 1882 and 1884. At about the same time he published several short special papers which, together with the volumes just mentioned, give the results of 15 years' field work in northern New York. It is not surprising therefore to find recorded in this short period as many additions to the mammalian fauna of the state as were made during the preceding 40 years. The species added to the New York list by Merriam at this time are: *Sciuropterus sabrinus macrotis*,[1] Canadian flying squirrel ('84d, p. 108) *Sorex fumeus*,[2] smoky shrew ('84d, p. 77), and *Tamias striatus lysteri*, northeastern chipmunk ('86, p. 242). This number appears small in view of the fact that more than twice as many species have since been added to the New York list from the Adirondack region alone. It is, however, a good illustration of the futility of even the most determined efforts, unaided by the methods of collecting afterward perfected chiefly by Dr Merriam himself.

1 Recorded as *S. volucella hudsonica*.

2 Recorded as *S. platyrhinus*.

During the past 10 years the results of these improved methods have made a strong impress on the list of New York mammals. In this comparatively short period 18 additions have been recorded, raising the total number known to have occurred in the state within historic times to 81. These additions, arranged chronologically, are:

Tursiops tursio (Fabricius), porpoise (True, '89, p. 34).

Delphinus delphis Linnaeus, porpoise (True, '89, p. 56, 57).

Napæozapus insignis Miller, woodland jumping-mouse (Miller, '93a, p 1).

Peromyscus canadensis (Miller), Canadian white-footed mouse (Miller, '93b, p. 56).

Sorex albibarbis (Cope), water shrew (Miller, '94, p 181).

Lepus floridanus transitionalis (Bangs), northeastern cottontail (Bangs, '95, p. 405).

Lepus floridanus mearnsi Allen, eastern prairie cottontail (Bangs, '95, p. 409).

Sorex hoyi Baird, Hoy's shrew (Merriam, '95, p. 90).

Sciurus hudsonicus loquax Bangs, southeastern red squirrel (Bangs, '96d, p. 161).

Synaptomys cooperi Baird, bog lemming (Batchelder, '96a, p. 185).

Microtus chrotorrhinus Miller, rock vole (Batchelder, '96a, p. 188).

Putorius vison lutreocephalus (Harlan), southeastern mink (Bangs, '96a, p. 4).

Sorex macrurus Batchelder, big-tailed shrew (Batchelder, '96b, p. 133).

Pipistrellus subflavus subflavus (F. Cuvier), Georgia bat (Fisher, '96 p. 196).

Pipistrellus subflavus obscurus Miller, dusky bat (Miller, '97b, p. 93).

Microtus nesophilus Bailey, Gull Island mouse (Bailey, '98a, p. 86; '98b, p. 783).

Evotomys gapperi rhoadsi Stone, New Jersey red-backed mouse (Mearns '98a, p. 333).

Synaptomys fatuus Bangs, northern bog lemming (Mearns, '98b, p. 348).

In the following table the growth of the list of New York mammals is shown in parallel columns. The names used by De Kay ('42) are given in the left hand column,[1] those used by Merriam ('82, '84 and '85) in the second, those adopted in the present paper in the third and the English names in the fourth.

[1] From De Kay's list I omit the species included without definite knowledge of their occurrence in New York.

DE KAY	MERRIAM	MILLER	COMMON NAME
....	....	Didelphis virginiana (p. 293)	opossum
....	....	Tursiops tursio (p. 295)	porpoise
....	....	Delphinus delphis (p. 295)	porpoise
Phocaena communis	....	Phocaena phocaena (p. 295)	harbor porpoise
Globicephalus melas	....	Globicephalus melas (p. 296)	blackfish
Phocaena orca	....	Orca orca (p. 296)	killer
Rorqualus rostratus	....	Hyperoodon rostratus (p. 296)	bottle-nosed whale
Physeter macrocephalus	....	Physeter macrocephalus (p. 297)	sperm whale
Balaena mysticetus	....	Balaena cisarctica (p. 297)	right whale
Bison americanus	....	Bison bison (p. 297)	American bison
Cervus virginianus	Cariacus virginianus	Odocoileus americanus (p. 299)	Virginia deer
Elaphus canadensis Elaphus americanus	Cervus canadensis	Cervus canadensis (p. 300)	eastern wapiti
Cervus alces	Alce americanus	Alce americanus (p. 302)	moose
Sciurus hudsonius	Sciurus hudsonicus	Sciurus hudsonicus gymnicus (p. 302) Sciurus hudsonicus loquax (p. 303)	Canadian red squirrel southeastern red squirrel
Sciurus niger Sciurus leucotis	Sciurus carolinensis leucotis	Sciurus carolinensis leucotis (p. 304)	northern gray squirrel
Sciurus vulpinus	Sciurus niger cinereus	Sciurus ludovicianus vicinus (p. 306)	northeastern fox squirrel
Sciurus striatus	.... Tamias striatus	Tamias striatus striatus (p. 307) Tamias striatus lysteri (p. 307)	southeastern chipmunk northeastern chipmunk
Arctomys monax	Arctomys monax	Arctomys monax (p. 308)	woodchuck
Pteromys volucella	Sciuropterus volucella Sciuropterus volucella hudsonica	Sciuropterus volans (p. 309) Sciuropterus sabrinus macrotis (p. 310)	southern flying squirrel Canadian flying squirrel
Castor fiber	Castor fiber canadensis	Castor canadensis (p. 311)	American beaver
Mus musculus	Mus musculus	Mus musculus (p. 313)	house mouse
Mus rattus Mus americanus	Mus rattus	Mus rattus (p. 314)	black rat
Mus decumanus	Mus decumanus	Mus decumanus (p. 313)	house rat
Mus leucopus	Hesperomys leucopus	Peromyscus leucopus noveboracensis (p. 315) Peromyscus canadensis (p. 316)	northeastern white-footed mouse Canadian white-footed mouse
....	....	Neotoma pennsylvanica (p. 317)	cave rat

Arvicola rufescens	Evotomys rutilus gapperi	Evotomys gapperi gapperi (p 318)	common red-backed mouse
		Evotomys gapperi rhoadsi (p. 321)	New Jersey red-backed mouse
		Microtus chrotorrhinus (p. 322)	rock vole
Arvicola riparius Arvicola hirsutus Arvicola oneida Arvicola xanthognathus	Arvicola riparius	Microtus pennsylvanicus (p. 323)	meadow mouse
		Microtus nesophilus (p. 324)	Gull Island mouse
	Arvicola pinetorum	Microtus pinetorum scalopsoides (p. 326)	northern pine mouse
Fiber zibethicus	Fiber zibethicus	Fiber zibethicus (p. 327)	muskrat
		Synaptomys cooperi (p. 328)	bog lemming
		Synaptomys fatuus (p. 329)	northern bog lemming
Meriones americanus	Zapus hudsonius	Zapus hudsonius (p. 329) Napaeozapus insignis (p. 330)	meadow jumping-mouse woodland jumping-mouse
Hystrix hudsonius	Erethizon dorsatus	Erethizon dorsatus (p. 331)	Canada porcupine
Lepus nanus	Lepus sylvaticus	Lepus floridanus mallurus (p. 332) Lepus floridanus transitionalis (p. 333)	southern cottontail northeastern cottontail
		Lepus floridanus mearnsi (p. 334)	eastern prairie cottontail
Lepus americanus	Lepus americanus Lepus americanus virginianus	Lepus americanus virginianus (p. 335)	southern varying hare
Felis concolor	Felis concolor	Felis oregonensis hippolestes (p. 336)	northeastern panther
Lyncus rufus	Lynx rufus	Lynx ruffus (p. 340)	wild cat
Lyncus borealis	Lynx canadensis	Lynx canadensis (p. 339)	Canada lynx
Vulpes virginianus		Urocyon cinereoargenteus (p. 341)	gray fox
Vulpes fulvus	Vulpes vulgaris pennsylvanicus	Vulpes fulvus (p. 342)	red fox
Lupus occidentalis	Canis lupus	Canis occidentalis (p. 343)	timber wolf
Ursus americanus	Ursus americanus	Ursus americanus (p. 347)	black bear
Lutra canadensis	Lutra canadensis	Lutra canadensis canadensis (p. 347)	northeastern otter
Mephitis americana	Mephitis mephitica	Mephitis mephitica (p. 348)	skunk
Gulo luscus	Gulo luscus	Gulo luscus (p. 350)	wolverine
	Putorius vison	Putorius vison vison (p. 350)	northeastern mink
Putorius vison		Putorius vison lutreocephalus (p. 350)	southeastern mink
Mustela pusilla Mustela fusca	Putorius vulgaris Putorius erminea	Putorius cicognani (p. 351)	Bonaparte's weasel
Putorius noveboracensis		Putorius noveboracensis (p. 352)	New York weasel
Mustela martes	Mustela americana	Mustela americana (p. 353)	marten
Mustela canadensis	Mustela pennanti	Mustela pennanti (p. 354)	fisher
Procyon lotor	Procyon lotor	Procyon lotor (p. 354)	raccoon

DE KAY	MERRIAM	MILLER	COMMON NAME
Phoca concolor	Phoca vitulina	Phoca vitulina (p. 355)	harbor seal
Stemmatopus cristatus		Cystophora cristata (p. 356)	hooded seal
		Sorex albibarbis (p. 357)	water shrew
	Sorex platyrhinus	Sorex fumeus (p. 357)	smoky shrew
		Sorex macrurus (p. 358)	big-tailed shrew
Sorex forsteri Otisorex platyrhinus	Sorex cooperi	Sorex personatus (p. 359)	masked shrew
		Sorex hoyi (p. 360)	Hoy's shrew
Sorex dekayi Sorex brevicaudus Sorex carolinensis	Blarina brevicauda	Blarina brevicauda (p. 360)	short-tailed shrew
Scalops aquaticus	Scalops aquaticus	Scalops aquaticus (p. 362)	naked-tailed mole
	Scapanus americanus	Parascalops breweri (p. 363)	hairy-tailed mole
Condylura cristata	Condylura cristata	Condylura cristata (p. 364)	star-nosed mole
Vespertilio subulatus	Vespertilio subulatus	Myotis lucifugus (p. 365) Myotis subulatus (p. 366)	little brown bat Say's bat
Vespertilio noctivagans	Vesperugo noctivagans	Lasionycteris noctivagans (p. 367)	silvery bat
		Pipistrellus subflavus subflavus (p. 368)	Georgia bat
		Pipistrellus subflavus obscurus (p. 368)	dusky bat
Vespertilio carolinensis	Vesperugo serotinus fuscus	Vespertilio fuscus (p. 369)	brown bat
Vespertilio pruinosus	Atalapha cinerea	Lasiurus cinereus (p. 369)	hoary bat
Vespertilio noveboracensis	Atalapha noveboracensis	Lasiurus borealis (p. 370)	red bat

TYPE LOCALITIES IN NEW YORK

Thirty one descriptions of supposed new mammals have been based on specimens from New York state. Of these 20 are now regarded as applying to previously named species, but the proper arrangement of the untenable names in synonymy so largely depends on an exact knowledge of specimens taken at the original locality ('topotypes'), that the matter assumes a special importance from the point of view of systematic zoology.

The names based on New York specimens with the localities at which the latter were taken are as follows[1]:

Elaphus americanus De Kay ('42, p. 120) Near mouth of Raquette river.

Elephas americanus De Kay ('42, p. 101) Ten miles east of Rochester.

Sciuropterus sabrinus macrotis Mearns ('98 b, p. 353) Hunter mountain (Catskills).

Mus americanus De Kay ('42, p. 81) Rockland co.

Mus agrarius americanus Kerr ('92, p. 231) New York state.

Mus sylvaticus **noveboracensis** Fischer ('29, p. 318) New York state.

Sitomys americanus **canadensis** Miller ('93 b, p. 55) Peterboro, Madison co.

Lemmus noveboracensis Rafinesque ('22, p. 3) Southern New York.

Arvicola rufescens De Kay ('42, p. 85) Low grounds near Oneida lake.

Arvicola oneida De Kay ('42, p. 88) Oneida lake.

Arvicola **scalopsoides** Audubon and Bachman ('41, p. 97) Long Island.

Arvicola fulvus Audubon and Bachman ('41, p. 295) St Lawrence co.

Microtus insularis Bailey ('98, p. 86) Great Gull Island.

Lynx montanus Rafinesque ('17, p. 46) Catskill mountains.

Felis **ruffa** Gueldenstaedt ('76, p. 484) Central New York.

Mustela pusilla De Kay ('42, p. 34) New York state.

Mustela fusca Bachman ('41, p. 94) Suffolk co.

Putorius agilis Audubon and Bachman ('54, p. 184) Rockland co.

Putorius noveboracensis Emmons ('40, p. 45) New York state.

Phoca concolor De Kay ('42, p. 53) New York harbor.

Otisorex platyrhinus De Kay ('42, p. 22) Tappan, Rockland co.

Sorex dekayi Bachman ('37 b, p. 377) Queens co.

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1 Names now regarded as tenable printed in HEAVY TYPE

Sorex fumeus Miller ('95, p. 50) Peterboro, Madison co.

Sorex macrurus Batchelder ('96 b, p. 133) Keene Heights, Essex co.

Pipistrellus subflavus obscurus Miller ('97 c, p. 93) Lake George.

Vespertilio **borealis** Müller ('76, p. 20) New York state.

Vespertilio gryphus F. Cuvier ('32, p. 15) Vicinity of New York city.

Vespertilio salarii F. Cuvier ('32, p. 15) Vicinity of New York city.

Vespertilio crassus F. Cuvier ('32, p. 18) Vicinity of New York city.

Vespertilio caroli Temminck ('35–41, p. 237) Vicinity of New York city.

Atalapha fuscata Rafinesque ('20, p. 2) Northern New York.

LIFE ZONES OF NEW YORK

The importance of an acquaintance with the life areas of a region as a key to the geographic distribution of its animals and plants is hardly to be overestimated. Indeed one of the most significant of recent developments in faunal zoology is the growing recognition of this fact. Such knowledge furnishes a ready and exact means of defining the ranges of species without the tedious enumeration of isolated localities, and offers moreover an explanation of the principal factor governing those associations of species that constitute local faunae and florae.[1] Briefly defined, a life zone is a transcontinental area bounded by certain isothermal lines and characterized by relative uniformity of fauna and flora. Together with the isotherms a life zone normally extends in an approximately east and west direction, but both are subject to endless deviations. Elevations in the surface of the earth cause the life zones to bend to the southward, often many hundreds of miles beyond their normal sea-level position, while hot, dry plains have an opposite, though less, effect. Furthermore a zone is not necessarily continuous. It often happens that isolated hills and mountains reach a sufficient hight to have about their summits the climatic conditions characteristic of a more northerly zone than that at their bases. If there has ever been direct means of communication between such an isolated zonal island and the main body of the life area to which it belongs, its fauna will more closely resemble that of the latter than that of the immediately contiguous region.[2] This is however to a certain degree

1 In this connection see especially Miller, '98.

2 On mountains situated far enough south and rising to a sufficient altitude, several successive zones will be encountered between base and summit (see Merriam, '90).

dependent on the extent of the "island". Thus the Hudsonian area in northern New York, while large enough to support a characteristic flora, is apparently too small to be inhabited by any typical Hudsonian assemblage of mammals. Effects similar to those of elevation are produced by isolated swamps (*see* Bailey '96, p. 250–51 and Batchelder, '96a, p. 192–93) and cold rock slides (*see* Batchelder, '96a, p. 188 and Miller, '98, p. 615–18). The reverse condition of a southern island in a more northerly zone is less frequently met with though it occasionally occurs.

In North America seven life zones are represented. These are (beginning at the north) the Arctic, Hudsonian, Canadian, transition, upper austral, lower austral and tropical. The temperatures limiting these life areas are tabulated as follows, by Merriam ('94, p. 237, '98, p. 55). It is to be noticed that the northern limit of each zone is determined by an isotherm representing the sum of the positive temperatures for the entire season of growth and reproduction, and that the southward distribution is governed by the mean temperature of a brief period during the hottest part of the year, (Merriam, '94, p. 237, '98, p. 54).

Governing temperatures

ZONES	NORTHERN LIMIT Sum of normal mean daily temperatures above 6° c. (43° F.)		SOUTHERN LIMIT Normal mean temperature of six hottest consecutive weeks	
	° C.	° F.	° C.	° F.
Arctic	....	....	[1]10	[1]50
Hudsonian	....	....	[1]14	[1]57.2
Canadian	....	....	18	64.4
Transition	5 500	10 000	22	71.6
Upper austral	6 400	11 500	26	78.8
Lower austral	10 000	18 000	....	....
Tropical	14 500	26 000	....	....

Within the limits of New York state, with its north and south extent of only 260 miles, the irregularities of surface are such that no less than four life zones are represented.[1] The areas that they occupy within the state are briefly as follows:

Hudsonian: Summits of the highest Adirondacks (and possibly of the Catskills also) above the region of perfect forest growth.

Canadian: Adirondack forest region, and many 'islands' on hilltops to the southward, specially in the Catskills.

1 Estimated from insufficient data.

2 It is probable that a fifth, the Arctic, should be recognized as occupying the treeless summits of some of the highest Adirondack peaks. The data are at present insufficient.

Transition: The main agricultural portion of the state

Upper austral: Hudson valley, the western part of Long Island, and the lake region.

While this is in general the distribution of the life zones in New York the details are very imperfectly known. A study of these details would be the first and most important step in a survey of the kind to which this paper is intended as a preliminary. The economic importance of such a survey in its bearing on the selection of crops for certain areas and the avoidance of crop parasites is very great. (*See* Howard '95, Merriam '98, and Plumb '98.)

Throughout this paper the geographic distribution of species will be stated so far as possible in terms of life zones. The salient features of the different zones however may first be considered in some detail.

Hudsonian zone. The area occupied by the Hudsonian zone in New York is too limited to support a characteristic mammalian fauna. *Microtus chrotorrhinus*, a typical Hudsonian mammal, probably occurs throughout the Adirondack region in favorable localities (*see* p. 322) in the area covered by the Canadian zone. It has also been found in the Catskills associated with *Synaptomys fatuus*, another Hudsonian species. At least one Hudsonian bird (*Hylocichla aliciae bicknelli*) breeds in the Catskills, while several such as *Parus hudsonicus*, *Spinus pinus* and *Picoides americanus* are found in the Adirondacks.

Among the flowering plants a number of characteristic Hudsonian forms occur on the summits of the higher Adirondacks. Peck ('80) enumerates the following species from the summit of Mt Marcy:

Solidago alpestris	Alpine golden-rod[1]
Nabalus nanus	low rattlesnake-root
Vaccinium caespitosum	dwarf bilberry
Vaccinium uliginosum	great bilberry
Rhododendron lapponicum	Lapland rose bay
Arenaria groenlandica	mountain sandwort
Diapensia lapponica	diapensia
Empetrum nigrum	black crowberry
Salix uva-ursi	bearberry willow
Juncus trifidus	highland rush
Scirpus caespitosus	tufted club-rush
Carex bigelovii	Bigelow's sedge
Poa laxa	wavy meadow-grass
Savastana alpina	Alpine holy grass.

1 The English names for plants are those adopted by Britton and Brown ('96, '97 and '98).

The period of active plant growth in this zone covers slightly less than half the year.

In a list of lepidoptera of the Adirondack region Lintner ('80) records 11 species of moths (*Phalaenidae*) all of which occur on Mt Washington, New Hampshire, and many of which are found also in Labrador, Iceland, Lapland, the Alps of central Europe, and the high mountains of western North America. It is probable that these should be regarded as Hudsonian forms, though more strictly speaking they may be members of the Arctic fauna.

Canadian zone. In New York the characteristic mammals of the Canadian zone are:

Sciurus hudsonicus gymnicus	Canadian red squirrel
Sciuropterus sabrinus macrotis	Canadian flying squirrel
Peromyscus canadensis	Canadian white-footed mouse
Evotomys gapperi gapperi	common red-backed mouse
Napaeozapus insignis	woodland jumping-mouse
Putorius vison vison	northern mink
Sorex albibarbis	water shrew
Sorex fumeus	smoky shrew
Sorex macrurus[1]	big-tailed shrew
Lasiurus cinereus	hoary bat

Many Canadian birds breed in New York, but it is necessary to mention a few of the more characteristic only. Among these

Dendragapus canadensis	Canada grouse [2]
Bonasa umbellus togata	northern ruffed grouse
Picoides arcticus	Arctic three-toed woodpecker
Empidonax flaviventris	yellow-bellied flycatcher
Contopus borealis	olive-sided flycatcher
Perisoreus canadensis	Canada jay
Loxia leucoptera	white-winged crossbill
Zonotrichia albicollis	white-throated sparrow
Junco hyemalis	slate-colored junco
Vireo philadelphicus	Philadelphia vireo
Dendroica maculosa	magnolia warbler
Dendroica coronata	myrtle warbler
Dendroica blackburniae	Blackburnian warbler
Anorthura hiemalis	winter wren
Regulus satrapa	golden-crowned kinglet
Hylocichla ustulata swainsoni	olive-backed thrush

1 This animal is so slightly known that its faunal position is still doubtful.

2 The English names for birds are those adopted by the American ornithologists union ('95).

Plants have as yet been so little studied with regard to zonal distribution that it is impossible to give a complete list of those whose southern limit coincides with that of the Canadian zone. The following species however belong with little doubt to this category:[1]

Clintonia borealis	yellow clintonia
Vagnera trifolia	three-leaved Solomon's seal
Unifolium canadense	false lily-of-the-valley
Streptopus amplexifolius	clasping-leaved twisted-stalk
Streptopus roseus	sessile-leaved twisted-stalk
Habenaria orbiculata	large round-leaved orchis
Habenaria obtusata	small northern bog orchis
Betula papyrifera	paper birch
Alnus alnobetula	green or mountain alder
Coptis trifolia	gold-thread
Actaea rubra	red baneberry
Actaea alba	white baneberry
Bicuculla canadensis	squirrel corn
Mitella nuda	naked bishop's cap
Ribes prostratum	fetid currant
Dalibarda repens	dalibarda
Fragaria canadensis	northern wild strawberry
Potentilla fruticosa	shrubby cinquefoil
Sorbus americana	American mountain ash
Ilicoides mucronata	wild or mountain holly
Acer spicatum	mountain maple
Circaea alpina	smaller enchanter's nightshade
Panax quinquefolium	ginseng
Cornus canadensis	low or dwarf cornel
Ledum palustre	narrowed-leaved Labrador tea
Ledum groenlandicum	Labrador tea
Kalmia glauca	pale or swamp laurel
Chiogenes hispidula	creeping snowberry
Gentiana linearis	narrow-leaved gentian
Sambucus pubens	red-berried elder
Viburnum alnifolium	hobble-bush
Linnaea borealis	twin-flower

While it may be that a few of the species enumerated are not of themselves sufficient to stamp a region as Canadian, no locality outside of this zone can have a fauna and a flora in which the mammals, birds and plants of these three lists predominate. The period of plant

[1] These are mostly included among the plants found on the Adirondack league club tract. (Smith '94 and '98).

activity in the Canadian zone covers slightly more than half the year. The season is therefore too short to allow this region to assume much agricultural importance. "In favored spots particularly along the southern border white potatoes, turnips, beets and the more hardy Russian apples and cereals may be cultivated with moderate success." (Merriam '98, p. 20)

Transition zone. The transition zone, which covers the greater part of New York state, is as its name suggests a region of intergradation between the boreal and austral life areas. More strictly speaking it is an area in which the extreme southern limit of a small but considerable number of boreal species overlaps the extreme northern limit of a large number of austral species. Its fauna and flora are therefore not readily susceptible of positive characterization, specially since few species are strictly confined to its limits. It may perhaps be best recognized negatively, that is by the absence of strictly boreal and strictly austral forms of life.

In New York at least two mammals are peculiar to the transition zone. These are both races of cottontail, *Lepus floridanus transitionalis* in the east and *L. floridanus mearnsi* in the west. A race of white-footed mouse, *Peromyscus leucopus noveboracensis* is also supposed to be confined to the transition zone, but the status of this subspecies is still open to question and it may eventually be shown that the animal is not separable from the typical upper austral form of the species. These three animals are of distinct southern affinities. At least six other austral mammals find their northern limit in the transition zone. They are:

Sciurus hudsonicus loquax	southeastern red squirrel
Sciuropterus volans	southern flying squirrel
Microtus pinetorum scalopsoides	northern pine mouse
Putorius vison lutreocephalus	southeastern mink
Scalops aquaticus	naked-tailed mole
Vespertilio fuscus	brown bat

On the other hand only the three following northern species range into this zone without passing south of it. These are:

Tamias striatus lysteri	northeastern chipmunk
Putorius richardsoni cicognani	Bonaparte's weasel
Parascalops breweri	hairy-tailed mole

The occurrence of this assemblage of mammals, together with the absence of the species mentioned in the lists of Canadian and upper austral species, will serve to identify any part of the transition zone in New York.

In the bird fauna of the transition zone southern species again predominate in a ratio of more than two to one. Some of the New York birds that find their northern breeding limit in this zone but which have an extensive range to the southward are:

Colinus virginianus	bob-white
Bonasa umbellus umbellus	ruffed grouse
Zenaidura macroura	mourning dove
Coccyzus americanus	yellow-billed cuckoo
Antrostomus vociferus	whip-poor-will
Empidonax minimus	least flycatcher
Icterus galbula	Baltimore oriole
Pipilo erythrophthalmus	towhee
Ammodramus savannarum passerinus	grasshopper sparrow
Ammodramus caudacutus	sharp-tailed sparrow
Cyanospiza cyanea	indigo bunting
Stelgidopteryx serripennis	rough-winged swallow
Lanius ludovicianus migrans	migrant shrike
Helminthophila chrysoptera	golden-winged warbler
Dendroica aestiva	yellow warbler
Dendroica discolor	prairie warbler
Compsothlypis americana	parula warbler
Cistothorus palustris	long-billed marsh wren
Galeoscoptes carolinensis	catbird
Harporhynchus rufus	brown thrasher
Hylocichla mustelina	woodthrush
Sialia sialis	bluebird

On the other hand only about a dozen of the birds that find their southern breeding limit in the transition zone of New York range widely toward the north. Some of these are:

Podilymbus podiceps	pied-billed grebe
Empidonax traillii alnorum	alder flycatcher
Carpodacus purpureus	purple finch
Vireo solitarius	blue-headed vireo
Helminthophila rubricapilla	Nashville warbler
Dendroica caerulescens	black-throated blue warbler
Dendroica pennsylvanica	chestnut-sided warbler
Parus atricapillus	chickadee
Hylocichla ustulata swainsoni	olive-backed thrush
Hylocichla fuscescens	Wilson's thrush

The almost total absence of exact knowledge of the distribution of plants is especially apparent when an attempt is made to catalogue the more prominent species characteristic of the transition zone. While there are doubtless many species confined to this zone it is impossible with the data at hand to make any positive statement concerning them. The flora of the region occupied by the transition zone may be recognized primarily by the absence of the strictly boreal and austral forms, and secondarily by the mixture of northern and southern types of which it is composed. As in the case of the mammals and birds the austral elements predominate. The following southern flowering plants, among others, find their northern limit in some part of the transition zone:

Pontederia cordata	pickerel-weed
Trillium grandiflorum	large-flowered wake-robin
Trillium cernuum	nodding wake-robin
Lilium philadelphicum	red lily
Smilax hispida	hispid green-brier
Smilax herbacea	carrion-flower
Gyrostachys cernua	nodding ladies' tresses
Chamaecyparis thyoides	southern white cedar
Juglans nigra	black walnut
Ulmus fulva	slippery, red or moose elm
Ulmus racemosa	cork or rock elm
Benzoin benzoin	spice-bush
Sassafras sassafras	sassafras or ague tree
Dianthera americana	dense-flowered water willow
Conopholis americana	squaw-root
Pentstemon hirsutus	hairy beard-tongue
Datura tatula	purple thorn-apple
Datura stramonium	Jamestown or jimson-weed
Asclepias verticillata	whorled milkweed
Asclepias tuberosa	butterfly-weed
Azalea viscosa	swamp pink or honeysuckle
Nyssa aquatica	large tupelo
Rhexia virginica	meadow-beauty
Meibomia grandiflora	pointed-leaved tick-trefoil
Meibomia paniculata	panicled tick-trefoil
Crotalaria sagittalis	rattle-box
Polygala polygama	racemed milkwort
Polygala nuttallii	Nuttall's milkwort

Among the northern species that find their southern limit somewhere in this zone may be mentioned:

Cypripedium reginae	showy ladies' slipper
Cypripedium hirsutum	large yellow ladies' slipper
Cypripedium parviflorum	small yellow ladies' slipper
Arethusa bulbosa	arethusa
Taxus minor	American yew
Thuja occidentalis	white cedar
Tsuga canadensis	hemlock
Corema conradii	Conrad's broom crowberry
Populus grandidentata	large-toothed aspen
Betula lutea	yellow birch
Menyanthes trifoliata	buckbean
Diervilla diervilla	bush honeysuckle
Comarum palustre	purple or marsh cinquefoil
Oxalis acetosella	white or true wood-sorrel

Plant life is active in this zone during two thirds of the year, and it is consequently the most northerly life area of any real agricultural importance. "Many vegetables, the sugar beet, chicory, oats and numerous varieties of plums, cherries, pears, grapes, white potatoes and cereals attain their highest perfection" (Merriam, '98, p. 20). The principal crops of the Atlantic division of the transition zone ('Alleghanian faunal area') tabulated by Merriam ('88, p. 21–24) are:

wheat (7 varieties)	currants (11 varieties)
barley	black currants (4 varieties)
rye	apples (90 varieties)
corn (8 varieties)	crab apples (16 varieties)
sorghum	pears (37 varieties)
oats (5 varieties)	quinces
sugar beet	cherries (31 varieties)
buckwheat	plums (41 varieties)
hops	grapes (17 varieties)
white potatoes	strawberries (13 varieties)
flax	

There can be little doubt that the area occupied by the transition zone in New York has been very materially increased by the clearing away of the forests. The process of local extension of the transition zone may be observed in any region where Canadian forests are in process of clearing from the southern side. As the cool forest cover-

ing is removed boreal species disappear, while their places are taken by austral forms. Instances of this process in New York have been cited by Miller ('93b. p. 63) and Mearns ('98b. p. 342, 345, 360). The observations of the former refer to the rapid replacement of the Canadian white-footed mouse, *Peromyscus canadensis*, by its more southerly relative, *P. leucopus noveboracensis*. Mearns says: "The interior region of the Catskills surrounding Kaaterskill Junction belongs, as a whole, to the Canadian, the lowest of the boreal faunae, though slightly mixed with the Alleghanian [transition] in the farming lands on the banks of Schoharie creek. There is some evidence, however, that certain mammals of the transition and upper austral zones, as the New England cottontail (*Lepus sylvaticus transitionalis*), deer mouse (*Peromyscus leucopus*), and gray fox (*Urocyon cinereoargenteus*), have but lately extended their ranges to this locality by following up the clearings."

The explanation of the climatic changes that induce this alteration in fauna would involve a more thorough knowledge of forest influence than is now available. Much could be done toward a solution of the problem by a thorough biologic and climatologic survey of a small Canadian area on the southern edge of the Adirondacks. After the normal conditions under which the Canadian fauna existed were well understood the area should be cleared and reduced to the condition of a brushy pasture. This would give opportunity for a duplicate set of observations after the change in fauna had taken place, and from a comparison of the two sets, important conclusions would undoubtedly be reached.

Upper austral zone. The upper austral zone enters New York in two widely separated regions, the Hudson valley, and the extreme western part of the state in the "lake region."

In addition to the southern species already mentioned as extending their ranges into the transition zone the strictly characteristic mammals of the austral zone are:

Didelphis virginiana	opossum
Tamias striatus striatus	southeastern chipmunk
Peromyscus leucopus leucopus	southeastern white-footed mouse
Neotoma pennsylvanica	cave rat
Lepus floridanus mallurus	southeastern cottontail
Urocyon cinereoargenteus	gray fox
Pipistrellus subflavus subflavus	Georgia bat
Pipistrellus subflavus obscurus[1]	dusky bat

1 The faunal position of this bat is not positively known.

Characteristic birds of the upper austral zone which breed in New York are:

Corvus ossifragus	fish crow
Cardinalis cardinalis	cardinal
Ammodramus maritimus	seaside sparrow
Piranga rubra	summer tanager
Helmitherus vermivorus	worm-eating warbler
Helminthophila pinus	blue-winged warbler
Seiurus motacilla	Louisiana water-thrush
Geothlypis formosa	Kentucky warbler
Icteria virens	yellow-breasted chat
Wilsonia mitrata	Wilson's warbler
Mimus polyglottos	mocking bird
Thryothorus ludovicianus	Carolina wren
Parus bicolor	tufted titmouse

Among the flowering plants of the upper austral zone are many characteristic species. Some of those that occur in New York are:[1]

Pinus virginiana	Jersey pine
Pinus echinata	yellow pine
Andropogon glomeratus	bushy beard-grass
Commelina communis	Asiatic day-flower
Commelina virginica	Virginia day-flower
Tradescantia virginiana	spiderwort
Heteranthera reniformis	mud plantain
Helonias bullata	swamp pink
Chrosperma muscaetoxicum	fly-poison
Muscari racemosa	starch grape-hyacinth
Gemmingia chinensis	blackberry lily
Listera australis	southern twayblade
Saururus cernuus	lizard's tail
Quercus digitata	Spanish oak
Quercus marylandica	barren oak
Quercus phellos	willow oak
Broussonetia papyrifera	paper mulberry
Nelumbo lutea	American lotus
Magnolia acuminata	cucumber-tree
Asimina triloba	North American papaw
Capnoides flavulum	pale corydalis

[1] All of these are recorded by Day ('82) Britton ('88) or Britton and Brown ('96, '97 and '98).

Liquidambar styraciflua	sweet gum
Crataegus uniflora	dwarf thorn
Stylosanthes biflora	pencil-flower
Meibomia laevigata	smooth tick-trefoil
Meibomia viridiflora	velvet-leaved tick-trefoil
Lespedeza repens	creeping bush-clover
Lespedeza stuvei	Stuve's bush-clover
Galactia regularis	milk pea
Galactia volubilis	downy milk pea
Strophostyles umbellata	pink wild bean
Ptelea trifoliata	three-leaved hop-tree
Euphorbia ipecacuanhae	wild ipecac
Euonymus americanus	strawberry bush
Ascyrum stans	St Peter's-wort
Lechea leggettii	Leggett's pin-weed
Aralia spinosa	Hercules' club
Erythraea pulchella	branching centaury
Asclepias variegata	white milkweed
Ipomoea pandurata	wild potato vine
Cuscuta coryli	hazel dodder
Phlox subulata	ground or moss pink
Monarda punctata	horse-mint
Paulownia tomentosa	Paulownia
Catalpa catalpa	catalpa, Indian bean
Diodia teres	rough button-weed
Viburnum nudum	larger withe-rod
Viburnum prunifolium	black haw
Lonicera sempervirens	trumpet honeysuckle
Helianthus angustifolius	narrow-leaved sunflower
Centaurea calcitrapa	star thistle

In the upper austral zone plant life is dormant for a very short period, two to three months only. This is in fact the lowermost zone in which a complete winter cessation of vegetable activity occurs. Agriculturally the Atlantic division of the upper austral zone is of even more importance than that of the transition zone, since in it flourish a large proportion of the important crops of the latter, while in addition many wholly absent from the more northerly zone reach their highest state of perfection. The principal crops of the Atlantic division of the upper austral zone ('Carolinian faunal area') are thus tabulated by Merriam ('88, p. 31–36).

wheat (6 varieties)
oats (4 varieties)
barley
rye
buckwheat
corn (8 varieties)
sorghum
sugar beet
white potatoes
tobacco
sweet potatoes
hemp
flax
cow-peas
lima beans
apples (123 varieties)
crab apples (4 varieties)
pears (43 varieties)
quinces (5 varieties)
plums (54 varieties)
cherries (26 varieties)
peaches (35 varieties)
nectarines (3 varieties)
apricots (2 varieties)
raspberries
strawberries (18 varieties)
grapes (30 varieties)

LIST OF MAMMALS

EXPLANATION

The subject-matter relating to each species in the present list is arranged so far as possible under seven heads, as follows: synonymy, type locality, faunal position, habitat, distribution in New York, principal records and remarks.

The synonymies contain references to first use of specific name, first use of combination adopted, and to the names used by the principal writers on the mammals of the state. Occasionally references to recent monographic papers have been added.

The only heading that calls for special remark is the sixth, "principal records." In this section I have brought together the essential parts of the records given by De Kay in the first volume of the *Natural history of New York* ('42), by Merriam in his *Mammals of the Adirondack region, northeastern New York* ('82 and '84d), by Fisher in his *Mammals of Sing Sing N. Y.* ('96) and by Mearns in his *Study of the vertebrate fauna of the Hudson highlands* ('98a) and *Notes on the mammals of the Catskill mountains* ('98b). The Catskill records of Mearns are always given, but the Hudson highlands notes are generally omitted unless they contain matter supplementary to that recorded by Fisher. In this section I have included my own observations, made principally at Peterboro, Madison co. and Elizabethtown, Essex co. Finally I have added the greater part of a list of the mammals of the vicinity of Buffalo communicated in a letter under date of March 3, 1898 by James Savage, and notes on the mammals of Long Island furnished by Arthur H. Helme of Miller Place, Suffolk co.

Throughout this paper, except in the tables of synonymy, bibliographic references are made by what is now generally known as the "Harvard" system. On pages 375–385 is given a complete list of the works referred to arranged alphabetically by authors. Under each author the separate papers are placed chronologically, each preceded by an abbreviation of the date on which it appeared. These abbreviations serve as an index. Thus for instance the reference "J. A. Allen '94b" would refer to the second paper published by J. A. Allen in 1894, the full citation of which may be found when needed.

RECENT SPECIES

Didelphis virginiana Kerr Opossum

1792 *Didelphis virginiana* Kerr, Animal kingdom 1 : 193.

1842 *Didelphis virginiana* De Kay, Zoology of New York, Mammalia p. 4.

1896 *Didelphis virginiana* Fisher, The Observer. May 1896, 7 : 194.

1898 *Didelphis virginiana* Mearns, Am. mus. nat. hist. Bul. 9 Sep. 1898, 10 : 330.

1898 *Didelphis virginiana* Mearns, U. S. Nat. mus. Proc. 21 : 360.

Type locality. Virginia.

Faunal position. The opossum is strictly an inhabitant of the austral zones.

Habitat. Woods, thickets and old fields.

Distribution in New York. Lower Hudson valley, Long Island and the lake region.

Principal records. De Kay, "Although it is abundant in New Jersey, I have never seen it in this state, but have heard that it has been noticed in the southern counties on the west side of the River Hudson, and it will probably be found in the western counties" ('42 p. 4).

Fisher, "Strictly speaking this animal should not be included in the present list [of the mammals found at Sing Sing, Westchester co.] because as far as known it has never been taken in Westchester county. Nevertheless it is tolerably common in Rockland and Orange counties two or three miles to the westward, and is only prevented from entering our domain by that ideal but insuperable barrier, the Hudson river. This broad, deep, powerful stream so dreaded by the old Dutch sailors of New Amsterdam, seems likewise to be feared and avoided by the equally slow-going opossum" ('96 p. 194).

Mearns: "In the [Hudson] highlands the opossum has always been fairly common since my boyhood, and hence long before its too 'suc-

cessful' introduction on Long Island, New York" ('98a, p. 330). "The opossum seems to be unknown in this portion of the Catskills [neighborhood of Schoharie valley] though it has been taken near the town of Catskill at the base of the mountains on the Hudson river side" ('98b, p. 360).

The animal has also been recorded from Crown Point, Essex co. (Fisher, '85a, p. 184), Rochester, Genesee co. (Lucas, '82 p. 7), Weedsport, Cayuga co. (Morehouse, '83 p. 467), Woodside, Long Island (Bragaw, '83 p. 467), Oakdale, Long Island (Fraser, '89 p. 212), Elmira, Chemung co. and Owego, Tioga co. (Loring, '99 p. 71). Hill ('82 p. 403) notes the escape from captivity of 12 individuals at Ithaca, Tompkins co. in 1878 or thereabouts.

Personally I have never met with the opossum in New York.

Mr Savage informs me of its occasional occurrence near Buffalo. That the animal is rare in the region is shown by the local interest its occasional capture arouses. Under date of April 15, 1899, Mr Savage writes: "Two 'possum records have been made within the last six months. One was taken alive at Mill Grove, Erie county, and came into the possession of County Clerk Wende, who is quoted in the newspapers as saying that it is the first opossum ever taken in New York state. The second was taken at Hamburg by Mr Edward Colvin of that place, and is reported in the *Buffalo express* of Feb. 19, 1899. It is said of this specimen that 'it is the first animal of the specie (sic) shot in this vicinity in 25 years.'"

Mr Helme says, "About 20 years ago reports began to accumulate of the capture of opossums in various parts of Long Island. In a few years the animal became very common and generally distributed".

Remarks. I have been unable to find the first authentic record of the opossum in New York. De Kay knew the animal as an inhabitant of the state by hearsay only. Audubon and Bachman remark, "We have no doubt that it will in time be found existing to the east of the Hudson in the southern counties of New-York as well as on Long-Island . . . as the living animals are constantly carried there . . . It has been stated to us that in New-Jersey within 5 or 10 miles of New-York, as many as 10 or 14 of these animals have . . . been taken" ('51 p. 124). Baird in 1858 did not include New York in the animal's range ('58 p. 232–33). In recent years however the records are frequent and positive, establishing the opossum on a firm basis among the austral animals that enter the state at its southern and western extremities. It is highly

probable that this species is one of those whose range in New York has been considerably extended within historic times.

Tursiops tursio (Fabricius) *Porpoise*

1780 *Delphinus tursio* Fabricius, Fauna Groenland p. 49.
1864 *Tursiops tursio* Gervais, Comptes rend. p. 876.
1889 *Tursiops tursio* True, U. S. Nat. mus. Bul. 36, p. 32, 158.

Type locality. Coast of Greenland.

Distribution in New York. This species probably occurs commonly on both coasts of Long Island.

Principal records. True records specimens from Fire Island and Turkey Gut.

Delphinus delphis Linnaeus *Porpoise*

1758 *Delphinus delphis* Linnaeus, Syst. nat., ed. 10, 77.
1842 *Delphinus delphis* DeKay, Zoology of New York, Mammalia p. 136.
1888 *Delphinus delphis* True, U. S. Nat. mus. Bul. 36, p. 45, 160.

Type locality. Coast of Europe.

Distribution in New York. The sea porpoise doubtless occurs along the entire coast of New York.

Principal records. De Kay speaks of the animal as common but records no specimens ('42 p. 136). It is probable that his animal was *Tursiops tursio*, and not the present species. True gives measurements of skulls from "New York bay" and "New York harbor" ('88 p. 48).

Phocaena phocaena (Linnaeus) *Harbor porpoise*

1758 *Delphinus phocaena* Linnaeus, Syst. nat. ed. 10 1 : 77.
1842 *Phocaena communis* De Kay, Zoology of New York, Mammalia p. 133.
1888 *Phocaena phocaena* Jordan, Manual of the vertebrate animals of the northern United States. ed. 5 p. 331.
1888 *Phocaena communis* True, U. S. Nat. mus. Bul. 36, p. 118, 179.
1896 *Phocaena communis* Fisher, The Observer. May 1896. 7 : 200.

Type locality. Coast of Europe.

Distribution in New York. The harbor porpoise is the commonest cetacean of the tide waters of the state. It ascends the Hudson river as far at least as Sing Sing.

Principal records. De Kay, "The porpoise, or porpess, is common in our rivers and bays, chiefly in the spring and summer months, where they appear in the train of the migratory *Clupidae* [herrings], among which they make great havoc" ('42 p. 134). Fisher, "Common in the [Hudson] river [near Sing Sing] during the summer months, occasionally coming into the shallow water of the cove" ('96 p. 200).

Globicephalus melas (Traill) *Blackfish*

1809 *Delphinus melas* Traill, Nicholson's journal, 22 : 81.
1842 *Globicephalus melas* De Kay, Zoology of New York, Mammalia p. 132.
1888 *Globicephalus melas* True, U. S. Nat. mus. Bul. 36, p. 133, 183.

Type locality. Coast of England.

Distribution in New York. While the eastern end of Long Island is the only locality in New York from which I have been able to find a positive record of the blackfish, the animal probably occurs occasionally on all parts of the coastline of the state.

Principal records. De Kay, "In 1834, I received an account of the capture of two others [blackfish] on the east end of Long Island. The details furnished on that occasion enabled me to refer them with exactness to this species" ('42 p. 133).

Orca orca (Linnaeus) *Killer*

1758 *Delphinus orca* Linnaeus, Systema naturae ed. 10, 1 : 77.
1842 *Phocaena orca* De Kay, Zoology of New York, Mammalia p. 135.
1888 *Orca orca* Jordan, Manual of the vertebrate animals of the northern United States. ed. 5, p. 331.
1888 *Orca gladiator* True, U. S. Nat. mus. Bul. 36, p. 187.

Type locality. Coast of Europe.

Distribution in New York. The killer has been found on the coast of Long Island.

Principal records. De Kay, "I have seen them off the coast of Long Island, on several occasions" ('42 p. 135).

Hyperoodon rostratus (Chemnitz). *Bottle-nosed whale*

1779 *Balaena rostrata* Chemnitz, Beschäft. der Berlin Gesell. Naturf. Freunde. 4 : 183.
1841 *Hyperoodon rostratus* Wesmall, Nouv. mem. acad. roy. Belg. 13 : 1–13.
1842 *Rorqualus rostratus* De Kay, Zoology of New York, Mammalia. p. 130.

Type locality. Spitzbergen.

Distribution in New York. This whale has been taken in New York waters only once, in 1822.

Principal records. De Kay, " The above discription was taken from a whale captured in the lower bay of New York in 1822. I had no opportunity of determining its sex, but was informed that it was a female" ('42 p. 131).

Physeter macrocephalus Linnaeus *Sperm whale*

1758 *Physeter macrocephalus* Linnaeus, Systema naturae. ed. 10. 1 : 75.
1842 *Physeter macrocephalus* De Kay, Zoology of New York, Mammalia. p. 128.

Type locality. North Atlantic.

Distribution in New York. Formerly abundant along the coast but now nearly exterminated.

Principal records. De Kay : " The sperm whale was formerly numerous on our coast where it is still occasionally captured " ('42, p. 129).

Balaena cisarctica Cope *Right whale*

1842 *Balaena mysticetus* De Kay, Zoology of New York, Mammalia. p. 124. Not *Balaena mysticetus* Linnaeus.
1865 *Balaena cisarctica* Cope, Acad. nat. sci. Phila. Proc. 17 : 169.

Type locality. "One [specimen] taken opposite this city [Philadelphia, Pa.] three years ago, one cast ashore at Rehoboth bay, Del., and one in Mobjack bay, Va." (Cope '65 p. 168).

Distribution in New York. Off the south coast of Long Island.

Principal records. De Kay : "Along the southern coast of Long Island, whale boats are still kept in readiness, and on the appearance of a whale the people in the vicinity quickly assemble, and are soon in pursuit of the animal" ('42 p. 125). Cope : " Some are known to enter New York harbor" ('65, p. 168).

Mr Helme writes that " the right whale is frequently seen off the south coast of Long Island in winter, and occasionally one is captured near the eastern end of the island."

Bison bison (Linnaeus) *American bison*

1758 *Bos bison* Linnaeus, Systema naturae. ed. 10. 1 : 172.
1842 *Bison americanus* De Kay, Zoology of New York, Mammalia. p. 110.
1888 *Bison bison* Jordan, Manual of the vertebrate animals of the northern United States. ed. 5. p. 337.

Type locality. Texas.

Faunal position. Boreal, transition and austral zones.

Habitat. Plains, prairies and forests.

Distribution in New York. The bison, exterminated in this state before the beginning of the present century, probably occurred throughout western New York, east at least as far as Syracuse.

Principal records. De Kay, "The bison, or American buffalo, has been long extirpated from this state; and although it is not at present found east of the Mississippi, yet there is abundant testimony from various writers to show that this animal was formerly numerous along the Atlantic coast from New York to Mexico" ('42, p. 110).

Allen, "The occurrence of a stream in western New York called Buffalo creek which empties into the eastern end of Lake Erie, is commonly viewed as traditional evidence of its occurrence at this point, but positive testimony to this effect has thus far escaped me. This locality, if it [the bison] actually came so far eastward, must have formed the eastern limit of its range along the lakes. I have found only highly questionable allusions to the occurrence of buffaloes along the southern shore of Lake Ontario. Keating, on the authority of Calhoun, however, has cited a passage from Morton's '*New English Canaan*' as proof of their former existence in the neighborhood of this lake. Morton's statement is based on Indian reports, and the context gives sufficient evidence of the general vagueness of his knowledge of the region of which he was speaking . . . The extreme northeastern limit of the former range of the buffalo seems to have been as above stated in western New York, near the eastern end of Lake Erie. That it probably ranged thus far, there is fair evidence" ('76, p. 107).

Hornaday. In his paper on the extermination of the American bison ('89, p. 385–86) Mr Hornaday repeats Dr Allen's statements concerning the former range of the bison in New York, but is able to add no further information. Under date of January 12, 1898, he writes me, "Since the publication of this memoir I have obtained what I consider perfectly reliable evidence that bison herds formerly visited the salt akes in the vicinity of Syracuse, and you are at liberty to mention the fact if you choose. I have not yet published the details, but intend to do so soon."

In reply to my inquiry concerning the former status of the bison in western New York, Hon. David F. Day of Buffalo replied as follows, "As to the occurrence of the bison in this state I can only say that, so far as my reading extends, the animal is not mentioned as an inhabitant

of our territory. Still I am persuaded that it was occasionally here. It is true that it did not like either the forest or the mountains. But still I think that it might have migrated from Ohio and entered this state through the narrow strip of level land in Chautauqua county, along the shore of Lake Erie, and thus have avoided the higher grounds and the foothills of the Alleghanies. I think it would have found food sufficient for its wants in several of the western counties of New York where flat lands occur. This would harmonize with the fact that on an early French map of western New York, a stream discharging into Lake Erie is laid down, to which the name " Rivière des boeufs" was given. The Indian name of this stream has never come to my knowledge. The name of this city and of the creek where its settlement began gives no evidence of the existence of the bison in this vicinity. The city was named after the creek and the creek after an old Indian named Buffalo who lived near its mouth."

Mr Savage writes, " In regard to the bison and the naming of our city, Buffalo certainly got its name from Buffalo creek, but the origin of the name of the creek is still a mooted question. Some contend that it came from an Indian named Buffalo (but where did he get his name?) who lived on the banks of the creek. Other streams near here were named in this way, as for instance Smokes creek and Scajaquada creek. The latter flows through our principal park, and the Indian for whom it is named was formerly a well known character. I think that the persons who investigated the matter about 20 years ago failed to find in the writings of the early travellers through this region any record of the bison having been seen in New York. The Seneca Indians are said to have had a tradition that the bison formerly visited a salt lick on Buffalo creek. About two months ago I was discussing the matter with the Hon. David F. Day, who suggested that perhaps the only way to settle the question would be to dig over the site of the supposed lick in search of bones. There is evidence that the bison formerly paid summer visits to licks in western Pennsylvania and eastern Ohio, but it is probable that they came into our state as straggling, transient visitors only."

Odocoileus americanus (Erxleben) *Virginia deer*

1777 [*Cervus dama*] *americanus* Erxleben, Syst. regn. anim. 312.
1842 *Cervus virginianus* De Kay, Zoology of New York, Mammalia. p.113.
1884 *Cariacus virginianus* Merriam, Linn. soc. New York. Trans. 2 : 9.
1896 *Cariacus americanus* Fisher, The Observer, May 1896, 7 : 198.
1898 *Dorcelaphus virginianus* Mearns, Am. mus. nat. hist. Bul. 9 Sep. 1898, 10 : 345.

Type locality. Southeastern Virginia.

Faunal position. The common deer of the northeastern United States is an inhabitant of the transition zone and lowest (Canadian) division of the boreal zone. The status of the deer of the upper austral zone is not thoroughly understood.

Habitat. Forests.

Distribution in New York. Deer occur abundantly throughout the extensive forests of northern New York.

Principal records. DeKay: "This well known animal is still found in almost every part of the state where there is sufficient forest to afford them food and cover" ('42, p. 114).

Merriam: "Deer are at present so abundant in most parts of the Adirondacks that they outnumber all the other large mammals together. . . . And there is every reason to believe that if proper game laws are enforced their numbers will not materially decrease" ('84d, p. 9).

Fisher: "The last deer killed near Sing Sing was a doe shot by Mr Charles Acher on December 10, 1861 . . . In a letter from my lamented friend George Ayles dated July 1, 1889, after describing a fishing trip made a few days previously to Colabaugh pond a small body of water five miles north of Sing Sing, he says, 'At the place where we put up near the pond the farmer told me that he had seen a fine deer feeding in the meadow near his house that morning' . . . I never heard that this deer was killed . . . " ('96, p. 198). Mearns: "The *Middletown journal,* issue of January 13, 1878, contains a notice of the capture of a deer near Middletown in Orange county New York. This record brings the species within the limits of the Hudson highlands, and is the only authentic one that I know of, but I am informed that deer are still occasionally found in the extreme northwest corner of Orange county" ('98a, p. 345–46).

Of the present distribution of deer on Long Island Mr Helme writes: "This animal was formerly common throughout the island, but is now restricted to an area containing about 25 square miles in the townships of Islip and Brook Haven. Here they are still plentiful thanks to the protection afforded them by the game preserves of the 'South Side gun club' and a few private estates."

Cervus canadensis (Erxleben) *Eastern wapiti*

1777 [*Cervus elaphus*] *canadensis* Erxleben, Syst. regn. anim. p. 305.

1842 *Elaphus canadensis* De Kay, Zoology of New York, Mammalia. p. 118.

1842 *Elaphus americanus* De Kay, Zoology of New York, Mammalia. p. 120.

1884 *Cervus canadensis* Merriam, Linn. soc. New York. Trans. 2 : 45.

Type locality. Eastern Canada.

Faunal position. Boreal and transition zones.

Habitat. Forests.

Distribution in New York. While the eastern wapiti formerly occurred throughout the state it has been extinct since the early part of the present century. In Pennsylvania the animal was not exterminated till within the past 40 years (Rhoads, '97c, p. 207–8).

Principal records. De Kay : "The stag is still found in the state of New-York but very sparingly and will doubtless be extirpated before many years. Mr Beach, an intelligent hunter on the Raquet, assured me that in 1836 he shot at a stag (or as he called it an elk) on the north branch of the Saranac. He had seen many of the horns, and describes this one as much larger than the biggest buck (*C. virginianus*), with immense long and rounded horns, with many short antlers. His account was confirmed by another hunter, Vaughan, who killed a stag at nearly the same place. They are found in the northwestern counties of Pennsylvania and the adjoining counties of New-York. In 1834, I am informed by Mr Philip Church, a stag was killed at Bolivar, Allegany co. My informant saw the animal and his description corresponds exactly with this species" ('42, p. 119). "In the cabinet of the Lyceum of natural history, New York, is a portion of a pair of horns attached to a fragment of skull, dug up near the mouth of the Raquet river in this state . . . A horn of the second year's growth was thrown out by a plough on Grand Isle [Lake Champlain]" ('42, p. 120–21).

Merriam quotes De Kay and adds, "I do not regard the above account of Messrs Beach and Vaughan as trustworthy for the reason that I have never been able to find a hunter in this wilderness, however aged, who had ever heard of a living elk in the Adirondacks. That the American elk . . . was at one time common in the Adirondacks there is no question. A number of their antlers have been discovered, the most perfect of which that I have seen is in the possession of Mr John Constable. It was found in a bog on Third lake of Fulton Chain in Herkimer co. Dr C. C. Benton, of Ogdensburg, has several specimens. . . . These specimens were discovered at Steele's Corners in St. Lawrence county. Mr Calvin V. Graves, of Boonville, N. Y. has two sections of elk horns that were 'ploughed up in an old beaver meadow in Diana,' Lewis co." ('84d, p. 45–47).

Under date of September 5, 1898, Dr Fred F. Drury, of Gouverneur, St Lawrence co., writes to Dr Frederick J. H. Merrill as follows: "I have recently come into possession of a pair of elk horns, dug up on a farm about four miles from this village. They were accidentally discovered while digging out a spring hole in a pasture to provide water for cattle during the dry season. One horn is in perfect state of preservation, the other has been influenced somewhat by exposure, but not enough to in any way destroy the symmetry. The perfect one measures from root to tip 39 inches, and biggest circumference 8¼ inches. They each have five prongs, and when placed in approximate apposition have at widest point a spread of 34 inches opposite biggest prong."

Alce americanus Jardine *Moose*

1835 *Alces americanus* Jardine, Naturalists library, 13 (Mammalia: deer, antelopes, camels, etc.) 125

1842 *Cervus alces* De Kay, Zoology of New York, Mammalia. p. 115.

1884 *Alce americanus* Merriam, Linn. soc. New York. Trans. 2: 40.

Type locality. Eastern Canada.

Faunal position. Canadian and transition zone.

Distribution in New York. The moose which once ranged throughout the state has been extinct in New York since the early sixties.

Principal records. De Kay:—"They are yet numerous in the unsettled portions of the state, in the counties of Essex, Herkimer, Hamilton, Franklin, Lewis and Warren, and since the gradual removal of the Indians they are now (1841) believed to be on the increase" ('42, p. 117).

Merriam: "It is not many years since the moose (Alce americanus) was a favorite object of pursuit in the Adirondacks, from which region it was exterminated as nearly as I can ascertain about the year 1861" ('84d, p. 40).

Sciurus hudsonicus gymnicus Bangs *Canadian red squirrel*

1842 *Sciurus hudsonicus* De Kay, Zoology of New York, Mammalia. p. 61 (part).

1884 *Sciurus hudsonicus* Merriam, Linn. soc. New York. Trans. 2: 111.

1894 *Sciurus hudsonicus* J. A. Allen, Am. mus. nat. hist. Bul. 7 Nov. 1894. 6:325.

1899 *Sciurus hudsonicus gymnicus* Bangs, New England zool. club. Proc. 1: 27. 31 Mar. 1899.

Type locality. Greenville (near Moosehead lake), Maine.

Faunal position. Canadian zone.

Habitat. This animal prefers the shelter of heavy coniferous forests. It is however by no means confined to the woods, as it wanders freely wherever attracted by congenial shelter and food supply.

Distribution in New York. The details of the distribution of the Canadian form of *Sciurus hudsonicus* in New York are quite unknown. The animal probably occurs throughout the large Canadian area in the northern part of the state, but it is impossible at present to say exactly where the transition to the southern form *loquax* takes place. Mr Bangs has recorded a specimen taken at Peterboro, Madison county, as an intermediate between the two subspecies ('96d, p. 160).

Principal records. De Kay: "This familiar and well known species is found from the arctic circle to the mountainous ranges of North Carolina and Tennessee" ('42, p. 62). Merriam: "The red squirrel is one of the commonest and best known of the mammalian inhabitants of the Adirondacks, being found in all parts of the wilderness at all seasons of the year" ('84d, p. 111).

Remarks. As I have already stated the limits of the range of this form of *Sciurus hudsonicus* in New York are very imperfectly known. The northern and southern races have been only very recently recognized, and the details of their ranges are yet to be worked out. De Kay clearly included both forms under the name *Sciurus hudsonicus*, but Merriam refers exclusively to the more northern subspecies.

Scirurus hudsonicus loquax Bangs *Southeastern red squirrel*

1842 *Sciurus hudsonicus* De Kay, Zoology of New York, Mammalia. p. 61 (part).

1896 *Sciurus hudsonicus* Fisher, The Observer. May 1896. 7:197.

1896 *Sciurus hudsonicus loquax* Bangs. Biolog. soc. Washington. Proc. 28 Dec. 1896. 10:161.

1898 *Sciurus hudsonicus loquax* Mearns, Am. mus. nat. hist. Bul. 9 Sep. 1898. 10:339.

1898 *Sciurus hudsonicus loquax* Mearns, U. S. Nat. mus. Proc. 21:352.

Type locality. Liberty Hill, New London co., Connecticut.

Faunal position. Transition zone and northern edge of upper austral zone.

Habitat. "Mixed woods, groves and in fact almost everywhere; perhaps most numerous where there are large tracts of *Pinus rigida*, the seeds of which it is very fond of" (Bangs, '96e, p. 161).

Distribution in New York. The details of distribution of the southeastern red squirrel in New York are as little known as those of the range of the Canadian subspecies. The animal undoubtedly occurs throughout

the region occupied by the transition zone and upper austral zone. This is probably one of the animals whose range has been extended by the clearing away of the heavy forests.

Principal records. De Kay: The quotation from this author cited under *S. hudsonicus gymnicus* refers without doubt in great part to the present form.

Fisher: "Common (at Sing Sing)" ('96, p. 197).

Mearns: "This lively inhabitant of the forest was found at all altitudes, its range extending from sea level to the highest peaks of the Catskills" ('98 p. 352).

I have never met with typical *Sciurus hudsonicus loquax* in New York. Specimens which I took at Peterboro, Madison co., have been identified by Mr Outram Bangs as intermediates between this form and true *hudsonicus.*

Mr Savage writes, "The red squirrel is found in almost every piece of woodland near Buffalo. I have recently learned of a curious albino family of these animals that seems worthy of record. Mr Henry Urban (grocer, cor. Oak and Genesee st.) has a beautiful albino that has been in his possession since 1888. He says that in that year Mr John Bergtold of Bowmansville, Erie co. captured an adult female and three young, all of which he kept alive. The adult and two of the young were perfect albinos, the other young one was normal in color. Mr Urban saw the family when alive and asked Mr Bergtold to give him any of the white animals that might die. Soon afterward he received the specimen that he now has."

Mr Helme states that the red squirrel is not found on Long Island.

Sciurus carolinensis leucotis (Gapper) *Northern gray squirrel*

1830 *Sciurus leucotis* Gapper, Zool. journ. 5: 206.

1842 *Sciurus niger* De Kay, Zoology of New York, Mammalia. p. 90 (part).

1842 *Sciurus leucotis* De Kay, Zoology of New York, Mammalia. p. 57 (part).

1877 *Sciurus carolinensis* var. *leucotis* Allen, Monogr. N. Am. Rodentia. p. 701.

1884 *Sciurus carolinensis leucotis* Merriam, Linn. soc. New York. Trans 2: 121.

1896 *Sciurus carolinensis leucotis* Fisher, The Observer. 7: 197.

1898 *Sciurus carolinensis leucotis* Mearns, Am. mus. nat. hist. Bul. 9 Sept. 1898. 10: 340.

1898 *Sciurus carolinensis leucotis* Mearns, U. S. Nat. mus. Proc. 21: 353.

Type locality. Region between York and Lake Simcoe, Ontario, Canada.

Faunal position. Transition zone and lowermost part of Canadian zone.

Habitat. "Hardwood forests and groves of oak, chestnut and hickory" (Bangs, '96e, p. 155). The gray squirrel is often abundant in parks, cemeteries and the outskirts of towns and cities.

Distribution in New York. The distribution of the gray squirrel in New York is remarkably irregular. The animal is often abundant in localities where it would not be expected to thrive, and as unaccountably absent from others. The cause of this irregularity is probably to be found in some variation in the food supply. That food has a very marked influence on the periodical increase and decrease of gray squirrels is well known. Dr Merriam writes, "This species . . . varies in abundance from year to year according to the conditions of the nut crop. . . . My notes show that the beechnut crop was good in the autumns of 1871, 1873, 1875, 1877, 1879, 1881, 1883--always on the odd years--while on the alternate seasons it failed. And strange as it may at first sight appear, squirrels are usually most numerous during the summer and early autumn of those years when there are few or no nuts. The reason is this: when the yield is large there is a noticeable influx of squirrels from distant parts, and they, together with those that were here at the time, winter well having an abundance of food, and breed here the following spring. During the summer and early autumn a multitude of young now nearly full grown mingle with the parent stock. Hence the species attains at this time its maximum in numbers. But this is the year when the nut crop is a failure. Therefore, as the fall advances and they find there is a scarcity of provision for the winter many of them migrate, we know not where. Then come the October "squirrel hunts"—a disgrace to the state as well as to the thoughtless men and boys who participate in them—and the number left to winter is deplorably small.

"As the abundance of the gray squirrel in winter is governed by the supply of beechnuts so is the presence at this season of its assailant, the red-headed woodpecker (*Melanerpes erythrocephalus*) determined by the same cause. I have elsewhere called attention to this fact, remarking that 'with us a squirrel year is synonymous with a good year for *Melanerpes*, and vice versa' ['81b, p. 347]. Gray squirrels, red-headed woodpeckers and beechnuts were numerous during the winters of 1871–72, 1873–74, 1875–76, 1877–78, 1879–80, 1881–82, 1883–84 while during the alternate years the squirrels and nuts were scarce, and the woodpeckers altogether absent." ('84d, p. 127–28).

Principal records. De Kay: "This well known little animal is found in every forest abounding in nuts of various kinds" ('42, p. 58). Merriam: This record has been quoted in sufficient detail. Fisher: "Periodically common. Some years hundreds are killed during the open season, while on the following year not over a dozen will be secured" ('96, p. 197). Mearns: "The gray squirrel is rare in this region [the Catskills]; but one individual was seen during our stay" ('98b, p. 353).

I have found the gray squirrel rare at Peterboro, Madison co.

Remarks. In his revision of the squirrels of eastern North America Mr Outram Bangs says that the southeastern gray squirrel, *Sciurus carolinensis carolinensis* ranges "north about to the lower Hudson valley." There is, however, no positive evidence as yet that this form actually occurs in New York.

Sciurus ludovicianus vicinus Bangs *Northeastern fox squirrel*

1842 *Sciurus vulpinus* De Kay, Zoology of New York, Mammalia. p. 59.
1884 *Sciurus niger cinereus* Merriam, Linn. soc. New York. Trans. 2:134.
1896 *Sciurus niger cinereus* Fisher, The Observer. May 1896. 7:197.
1896 *Sciurus ludovicianus vicinus* Bangs, Biolog. soc. Washington. Proc. 28 Dec. 1896, 10:150.

Type locality. White Sulphur springs, West Virginia.

Faunal position. The northeastern fox squirrel is an inhabitant of the upper austral zone, but occasionaly it wanders into the transition zone.

Habitat. Extensive forests.

Distribution in New York. In New York the occurrence of the fox squirrel can now be regarded as little more than accidental. Formerly however it was found in considerable numbers.

Principal records. De Kay: "Its habits and geographic distribution are the same as in the preceding [*S. leucotis*]" ('42, p. 60). Merriam: "The fox squirrel can not at present be regarded as other than a rare or accidental straggler in the Adirondack region. So far as I am aware the only specimen taken here of late was killed by Oliver B. Lockhardt at Lake George, Warren co. in 1872 or 1873" ('84d, p. 134). Fisher: "Mr Gilbert C. Merritt once informed me that he had killed several fox squirrel in the Chappaqua hills about the year 1850. Of late none have been heard of even in that wild region" ('96, p. 197).

Mr Savage writes that there is an old mounted specimen of this animal in the museum of the Buffalo Society of natural science, labeled 'Erie county.' He does not consider the record as positive however, since all definite history of the specimen is lacking.

Mr Helme informs me that the fox squirrel does not occur on Long Island.

Tamias striatus striatus (Linnaeus) *Southeastern chipmunk*

1758 *Sciurus striatus* Linnaeus, Syst. nat. ed. 10. 1 : 164.

1842 *Sciurus striatus* De Kay, Zoology of New York, Mammalia. p. 62 (part).

1857 *Tamias striatus* Baird, 11th Smithsonian report. p. 55 (part).

1886 *Tamias striatus* Merriam, American naturalist. Feb. 1896. 20 : 242.

1896 *Tamias striatus* Fisher, The Observer. May 1896. 7 : 196.

1898 *Tamias striatus* Mearns, Am. mus. nat. hist. Bul. 9 Sep. 1898. 10 : 338.

Type locality. Virginia and Carolina.

Faunal position. Upper austral zone.

Habitat. Thickets, rocky ledges and dry, open woods.

Distribution in New York. The southeastern chipmunk reaches New York, so far as at present known, in the lower Hudson valley only. I have never seen a specimen from the upper austral area in the western part of the state, and therefore can not say positively which form occurs there.

Principal records. De Kay did not distinguish between the two forms of chipmunk now known to occur in New York, but his references to the animal show that he included both under the name *Sciurus striatus* ('42, p. 62). Fisher: "Common [at Sing Sing]" '96, p. 196. Mearns: "The southern chipmunk is by far the most abundant member of the squirrel family in the Highlands. It lives everywhere, from the islands of the Hudson to the highest mountain tops, though it is least common on the high ground" ('98a, p. 338).

Of the chipmunk on Long Island Mr Helme writes, "This animal is common. A few years ago it was nearly exterminated, but now it has become plentiful again. The cause of this decrease in numbers was due I believe to an extremely cold winter following an autumn in which the food supply was short."

Tamias striatus lysteri (Richardson) *Northeastern chipmunk*

1829 *Sciurus* (*Tamias*) *lysteri* Richardson, Fauna Boreali-Americana. 1 : 182.

1842 *Sciurus striatus* De Kay, Zoology of New York, Mammalia. p. 62 (part).

1884 *Tamias striatus* Merriam, Linn. soc. New York. Trans. 2 : 135.

1886 *Tamias striatus lysteri* Merriam, American naturalist. Feb. 1886. 20 : 242.

1898 *Tamias striatus lysteri* Mearns, U. S. Nat. mus. Proc. 21 : 352.

Type locality. Penetanguishene, Georgian Bay, Ontario, Canada.

Faunal position. Transition zone and warmer, more open parts of Canadian zone.

Habitat. The habitat of the northeastern chipmunk is the same as that of its southern relative.

Distribution in New York. The northeastern chipmunk is very generally distributed throughout the greater part of New York state. Specimens intermediate between the two races have been taken in the lower Hudson valley by Mearns (Miller '97 p. 30).

Principal records. De Kay: "It is common over all the state" ('42, p. 64). Merriam: "The chipmunk or ground squirrel is always present in greater or less numbers in some parts of the Adirondacks. It is a migratory animal and is exceedingly abundant some years, while during others it is scarcely seen at all, the difference being dependent on the quantity of the food supply" ('84d, p. 135). Mearns: "The chipmunk of the Schoharie valley is distinctly of the *lysteri* type. It was common but shy, occurring from the edge of the creek (altitude 1700 feet) up to the summit of Hunter mountain (altitude 4025 feet). At Palenville, on the Hudson river side of the Catskills, intermediates between the forms *striatus* and *lysteri* occur; in the Hudson highlands a few individuals from the highest elevations verge toward *lysteri*; and lower down the Hudson valley only true *striatus* is found. No difference was detected between specimens collected in spruce forests and balsam swamps on the mountains and those from the fields and fences along Schoharie creek" ('98, p. 352).

I have found *Tamias striatus lysteri* abundant at Peterboro, Madison co., and at Elizabethtown, Essex co.

Arctomys monax (Linnaeus) *Woodchuck*

1758 *Mus monax* Linnaeus, Syst. nat. ed. 10. 1: 60.

1780 *Arctomys monax* Schreber, Säugethiere. 4: pl. 208.

1842 *Arctomys monax* De Kay, Zoology of New York, Mammalia. p. 69.

1884 *Arctomys monax* Merriam, Linn. soc. New York. Trans. 2: 142.

1896 *Arctomys monax* Fisher, The Observer. May 1896. 7: 196.

1898 *Arctomys monax* Mearns, Am. mus. nat. hist. Bul. 9 Sep. 1898. 10: 338.

1898 *Arctomys monax* Mearns, U. S. Nat. mus. Proc. 21: 352.

Type locality. Maryland.

Faunal position. The range of the woodchuck is now supposed to extend from well within the upper austral zone through the Canadian zone.

Habitat. Principally meadows and cleared land, but the animal is found in almost every variety of situation providing suitable ground for the construction of extensive burrows.

Distribution in New York. The woodchuck probably occurs in every county of New York. While it is probable that the range of this animal has not been materially affected by the settlement of the country, there can be little doubt that there are more woodchucks now in the state than there were before the arrival of the white settlers.

Principal records. DeKay: "The woodchuck . . . is common in almost every county in the state" ('42, p. 69). Merriam: "The woodchuck is rare . . . within the proper limits of the Adirondacks, though he has been found sparingly in the remotest parts of the wilderness. In the cultivated area surrounding the Adirondacks he is very abundant" ('84 d, p. 142). Fisher: "Common [at Sing Sing]" ('96, p. 196). Mearns: "This species is . . . tolerably common in the Schoharie valley" ('98 b, p. 352).

I have found the woodchuck common at Geneva, Ontario co. and Peterboro, Madison co.

Mr Savage writes, "The woodchuck is more common in the hills south and east of Buffalo than in the flat country immediately about the city. However I know of a family of 'chucks' in a bank less than three miles from my home."

Mr Helme writes that the woodchuck though common on Long Island is in certain localities less numerous than it was a few years ago. He attributes this fact to the effect of bounties offered by several townships for the animals' scalps.

Remarks. It is probable that the woodchuck of the Canadian forests is not true *Arctomys monax.* The material necessary to decide the question is lacking. For an account of the tree-climbing propensities of the woodchuck see Merriam '81 a.

Sciuropterus volans (Linnaeus) *Southern flying squirrel*

1758 *Mus volans* Linnaeus, Syst. nat. ed. 10. 1 : 63.

1842 *Pteromys volucella* De Kay, Zoology of New York, Mammalia. p. 66 (part).

1884 *Sciuropterus volucella* Merriam, Linn. soc. New York. Trans. 2 : 99.

1890 *Sciuropterus volans* Jordan, Man. vertebr. anim. northeastern U. S. ed. 5. p. 324.

1896 *Sciuropterus volucella* Fisher, The Observer. May 1896. 7:197.

1896 *Sciuropterus volans* Bangs, Biolog. soc. Washington. Proc. 28 Dec. 1896. 10:164.

1898 *Sciuropterus volans* Mearns, Am. mus. nat. his. Bul. 9 Sep. 1898. 10:341.

Type locality. Virginia.

Faunal position. The southern flying squirrel is a characteristic inhabitant of the austral zones and the transition zone. It barely reaches the lower edge of the Canadian zone in favorable localities.

Habitat. Woodlands, orchards, parks, buildings; wherever convenient shelter can be found.

Distribution in New York. The southern flying squirrel probably occurs throughout New York state except in large tracts of Canadian forest. The details of its overlapping in range with the Canadian flying squirrel remain to be worked out.

Principal records. De Kay: "The flying squirrel is well known throughout state" this ('42, p 66). Merriam: "Two varieties of flying squirrel occur in the Adirondacks: the present form, confined mainly to the borders of the region, and a northern race, commonest in the elevated portions of the interior" ('84 d, p. 99). Fisher: "Common [at Sing Sing]. In the daytime they remain quietly in hollow trees, bird houses, out buildings, hay lofts, or garrets of houses, and as dusk approaches come out of their hiding places and start off on foraging expeditions" ('96, p. 197).

I have found the southern flying squirrel at Peterboro, Madison co., though it is apparently less numerous there than the Canadian species. I have also taken it at Geneva, Ontario county.

Mr Savage writes: "The flying squirrel is seldom met with in the vicinity of Buffalo, but it is probably more common than is generally supposed. I took a pair December 8, 1897."

According to Mr Helme the flying squirrel is common on Long Island.

Sciuropterus sabrinus macrotis Mearns *Canadian flying squirrel*

1842 *Pteromys volucella* De Kay, Zoology of New York, Mammalia. p. 66 (part).

1884 *Sciuropterus volucella hudsonius* Merriam, Linn. soc. New York. Trans. 2:108. (Not *Sciurus hudsonius* Gmelin).

1896 *Sciuropterus sabrinus*, Bangs, Biolog. soc. Washington. Proc. 28 Dec. 1896. 10:162 (part).

1898 *Sciuropterus sabrinus macrotis* Mearns, U. S. Nat. mus. Proc. 21:353.

Type locality. Hunter mountain (Catskills) Greene co., New York.

Fanual position. Canadian zone.

Habitat. Forests.

Distribution in New York. In New York this animal is found throughout the great boreal area in the northern part of the state, and on the numerous boreal "islands" south of this region. In many localities on the border line between the transition zone and Canadian zone it is found associated with the smaller species *S. volans* but the two animals never intergrade (see *Merriam* '84d, p. 108, and Bangs, '96d, p. 163).

Principal records. DeKay: See last species. Merriam: "The northern flying squirrel is a common inhabitant of the elevated central area of the Adirondacks and is not particularly rare about the outskirts of the region, where I have found both varieties nesting in adjoining trees" ('84d, p. 108) Mearns: "This species was found in spruce woods on the ridge of Hunter mountain [Catskills], at the altitude of 3300 feet. Flying squirrels are said to be common everywhere in the region. One seen on August 7, 1896 near the base of East Kill mountain at 1800 feet altitude may have been either the present species or *Sciuropterus volans* (Linnaeus)" ('98b, p. 354).

I have taken the Canadian flying squirrels at Peterboro, Madison co., and at Elizabethtown, Essex co. It is common at each locality.

Castor canadensis Kuhl *American beaver*

1820 *Castor canadensis* Kuhl, Beitrage zur Zoologie und vergl. Anat. p. 64.

1842 *Castor fiber* De Kay, Zoology of New York, Mammalia. p. 72.

1884 *Castor fiber canadensis* Merriam, Linn. soc. New York. Trans. 2:155.

1898 *Castor canadensis* Mearns, Am. mus. nat. hist. Bul. 9 Sep. 1898. 10:351.

Type locality. Hudson bay.

Faunal position. Partly on account of the animal's aquatic habits, and partly on account of lack of definite knowledge of its geographic variations, it is impossible at present to assign the beaver a satisfactory faunal position. Beaver are known to range from the southern part of the lower austral zone in the south to the northern edge of the Hudsonian zone in the north. Surprising as it may seem there is at present no means for determining whether more than one race occurs in this area.[a]

[a] Since this was written, Mr S. N. Rhoads has divided the beaver into two races, a boreal form, true *Castor canadensis* and an austral form, *C. canadensis carolinensis*. (Trans. Am. philos. soc., NS., September 1898 19:417-23).

Habitat. Borders of streams, ponds and lakes.

Distribution in New York. The beaver is probably nearly exterminated if not quite extinct in New York. Concerning the animal's status I have nothing to add to the account given by Merriam in 1884.

Principal records. De Kay: "The beaver, whose skins once formed so important an article of commerce to this state as to have been incorporated in the armorial bearings of the old colony, is now nearly extirpated within its limits . . . In the summer of 1840 we traversed those almost interminable forests on the highlands separating the sources of the Hudson and the St Lawrence, and included in Hamilton, Herkimer and a part of Essex counties. In the course of our journey we saw several *beaver signs* as they are termed by the hunters. The beaver has been so much harassed in this state that it has ceased making dams, and contents itself in making large excavations in the banks of streams. Within the past year (1841) they have been seen on Indian and Cedar rivers, and at Pashungamah on Tupper's lake; and although they are not numerous, yet they are still found in scattered families in the northern part of Hamilton, the southern part of St Lawrence and the western part of Essex counties. Through the considerate attention of Mr A. McIntyre those yet existing in the southern part of Franklin co. are carefully preserved from the avidity of the hunter and there probably the last of the species in the Atlantic states will be found" ('42, p. 73–74).

Merriam: "That the beaver was once abundant in all parts of the Adirondacks is attested by the numerous remains and effects of their dams, but at present they are so exceedingly rare that few people know that they still exist here . . . During the fall of 1880 a beaver was caught on Raquette river between the Upper Saranac and Big Tupper's lake and about a mile below the 'Sweeney carry' . . . Subsequent to this date saplings were cut in the neighborhood showing that another was at work there . . . At present there is a small colony of beavers on a stream that empties into the west branch of the St Regis river. It is probably the colony referred to by De Kay in 1842 as 'yet existing in the southern part of Franklin co.'" (84d, p. 155–58).

Mearns: "When I was a boy the remains of a beaver-dam were plainly visible at Bog Meadow pond, in Orange co. When this pond was raised a few years ago to supply the town waterworks at Highland falls the dam was submerged, and with it disappeared the last vestige of the beaver, long extinct in the [Hudson] highlands" ('98a, p. 351–52).

Mus musculus Linnaeus *House mouse*

1758 [*Mus*] *musculus* Linnaeus, Syst. nat. ed. 10. 1 : 62.
1842 *Mus musculus* De Kay, Zoology of New York, Mammalia. p. 82.
1884 *Mus musculus* Merriam, Linn. soc. New York. Trans. 2 :162.
1896 *Mus musculus* Fisher, The Observer. May 1896. 7 :197.
1898 *Mus musculus* Mearns, Am. mus. nat. hist. Bul. 9 Sep. 1898. 10: 3379.
1898 *Mus musculus* Mearns, U. S. Nat mus. Proc. 21 :351.

Type locality. Sweden.

Faunal position. The house mouse on account of its semi-domestication can not be assigned to any definite faunal position.

Habitat. Buildings, fields, and occasionally woodlands.

Distribution in New York. This animal is abundant throughout the settled part of New York. It is by no means strictly confined to buildings.

Principal records. De Kay : " This familar little species has also been introduced from Europe into this country since its discovery. It has everywhere followed the footsteps of man . . . " ('42, p. 82). Merriam : " I have observed the house mouse in many of the camps scattered through the Adirondacks and have killed it, though rarely, at a considerable distance from the habitations of man. It is common in the fertile valleys along the outskirts of the wilderness, living in the fields during the short summer season, and returning to the dwellings, barns and haystacks at the approach of winter" ('84, p. 162). Fisher : "Common in the corn and rye fields as well as around buildings" ('96, p. 197). Mearns : " Common in fields and houses. Several were trapped under stacks of fodder corn standing in the fields. None were caught in the woods" ('98b, p. 351).

I have found the house mouse abundant at Geneva, Ontario co. Peterboro, Madison co. and Elizabethtown, Essex co.

Mr Savage reports it abundant at Buffalo.

Helme : " The house mouse is abundant on Long Island."

Mus decumanus Pallas *House rat*

1778 *Mus decumanus* Pallas, Nov. Sp. Quadr. e Glir. Ord., p. 91.
1842 *Mus decumanus* De Kay, Zoology of New York, Mammalia. p. 79.
1884 *Mus decumanus* Merriam, Linn. soc. New York. Trans. 2 : 161.
1896 *Mus decumanus* Fisher, The Observer. May 1896. 7 : 197.
1898 *Mus decumanus* Mearns, Am. mus. nat. hist. Bul. 9 Sep. 1898. 10 : 336.
1898 *Mus decumanus* Mearns, U. S. Nat. mus. Proc. 21 : 351.

Type locality. Russia.

Faunal position. As with the other introduced species of old world rats it is impossible to assign this animal a definite faunal position.

Habitat. Houses, outbuildings and fields.

Distribution in New York. The house rat occurs throughout New York, wherever there are towns or settlements.

Principal records. De Kay: "In this country it was introduced with the foreign mercenaries during the revolutionary war. They are now numerous in all the states, and have even extended to Canada" ('42, p. 80). Merriam: "This ubiquitous naturalized exotic is found even within the confines of the Adirondacks. But his presence here omens no good. Like the lumberman, whose footsteps he follows, he is the personification of destruction and desecrates the soil on which he treads" ('84d, p. 161). Fisher: "Common [at Sing Sing]" ('86, p. 197). Mearns: "Abundant. One was trapped at the base of East Kill mountain at the altitude of 2000 feet" ('98b, p. 351).

I have found the house rat at Geneva, Ontario co.; Peterboro, Madison co. and Elizabethtown, Essex co. Mr Savage reports it abundant in the neighborhood of Buffalo, and Mr Helme reports it equally numerous on Long Island.

Mus rattus Linnaeus *Black rat*

1758 [*Mus*] *rattus* Linnaeus, Syst. nat. ed. 10. 1:61.

1842 *Mus rattus* De Kay, Zoology of New York, Mammalia. p. 80 (part).

1842 *Mus americanus* De Kay, Zoology of New York, Mammalia. p. 81 (part).

Type locality. Sweden.

Faunal position. Not now determinable as the animal has been too widely distributed by artificial means.

Habitat. Houses and buildings of various kinds.

Distribution in New York. It is doubtful whether the black rat still exists in New York.

Principal records. De Kay: "It is now exceedingly rare" ('42, p. 81). The animal is not mentioned by Merriam, Fisher or Mearns.

I have never seen the black rat in New York. Many of the older inhabitants at Peterboro, Madison co. have told me of the immense numbers in which the 'blue rats' or 'barn rats' once occurred. To judge from these accounts, which I consider trustworthy, this animal must have been more abundant than its successor the house rat. Mr Hiram Wilson

of Oneida, Madison co. writes me, under date of February 3, 1898, that he first saw the brown rat when his family moved to Oneida valley in 1837. Previously the Wilsons had lived near Peterboro (about 12 miles distant), where only the black rat occurred.

Peromyscus leucopus noveboracensis (Fischer) *Northeastern white-footed mouse*

1829 [*Mus sylvaticus*] Δ *Noveboracensis* Fischer. Synopsis mammalium. p. 318.

1830 *Cricetus myoides* Gapper, Zool. journ. 5 : 204.

1842 *Mus leucopus* De Kay, Zoology of New York, Mammalia. p. 82.

1884 *Hesperomys leucopus* Merriam, Linn. soc. New York. Trans. 2 : 165 (part).

1896 *Peromyscus leucopus* Fisher, The Observer. May 1896. 7 : 197.

1897 *Peromyscus leucopus myodes* (*sic*) Rhoads, Acad. nat. sci Philadelphia. Proc. p. 27.

1897 *Peromyscus leucopus noveboracensis* Miller, Boston soc. nat. hist. Proc. 30 Ap. 1897. 28 : 22.

1898 *Peromyscus leucopus* Mearns, Am. mus. nat. hist. Bul. 9 Sep. 1898. 10 : 334.

1898 *Peromyscus leucopus* Mearns, U. S. Nat. mus. Proc. 21 : 350.

Type locality. New York.

Faunal position. Transition zone and lowermost edge of Canadian zone.

Habitat. Dry, open woods, thickets, fields, outbuildings and occasionally houses.

Distribution in New York. The northeastern white-footed mouse occurs throughout New York state except in the boreal area occupied by the Canadian white-footed mouse, and in a few localities where the genus *Peromyscus* is not found. It is possible that in the lower Hudson valley this form is replaced by the southeastern white-footed mouse as implied by Rhoads ('97a, p. 27), but I am not satisfied that this is actually the case.

Principal records. De Kay: "The jumping [=white-footed] mouse is found in every part of the state, and is said to build its nest in trees" ('42, p. 83). Merriam: "The white-footed mouse is common in all parts of the Adirondacks" ('84d, p. 165). Fisher: "Common [at Sing Sing]. This mouse is found everywhere in the woods and groves about fence rows, and in fall and winter ventures to the stacks and out-houses" ('96, p. 197-98). Mearns: "This beautiful mouse was rather abun-

dant along Schoharie creek, especially about farms and buildings. On the right side of Schoharie creek it was found sparingly distributed around the lower third of East Kill mountain, but was nowhere abundant above the creek bottom. On the left side it was not found above 2000 feet altitude. . . . In the Highlands of the Hudson *P. leucopus* is abundant, but in the highest parts where the black spruce and tamarack grow, no species of *Peromyscus* could be found. In other words where *P. canadensis* should have been found the genus was unrepresented" ('98b, p. 350).

I have taken the northeastern white-footed mouse at Geneva, Ontario co.; Peterboro, Madison co. and Elizabethtown, Essex co. At Peterboro and Elizabethtown it occurs in association with *P. canadensis*, the habitats of the two animals overlapping at the edges of forests and woodlands.

Mr Savage reports the animal common about Buffalo.

Of the white-footed mouse on Long Island Mr Helme writes: "This is an abundant species on all parts of the island. During cold weather several will often be found occupying one nest. I have taken as many as 16 at one time in a nest under a hollow log."

Peromyscus canadensis (Miller) *Canadian white-footed mouse*

1842 *Mus leucopus* De Kay, Zoology of New York, Mammalia. p. 82 (part).

1858 *Hesperomys myoides* Baird, Mam. N. Am. p. 472 (part).

1884 *Hesperomys leucopus* Merriam, Linn. soc. New York. Trans. 2:165 (part).

1893 *Sitomys americanus canadensis* Miller, Biolog. soc. Washington. Proc. 20 June 1893. 7:55.

1896 *Peromyscus canadensis* Bangs, Biolog. soc. Washington. Proc. 19 Mar. 1896. 10:49.

1898 *Peromyscus canadensis* Mearns, U. S. Nat. mus. Proc. 21:350.

Type locality. Peterboro, Madison co., New York.

Faunal position. Canadian zone.

Habitat. While the Canadian white-footed mouse is primarily an inhabitant of dense, damp forests it may be found in an almost endless variety of situations.

Distribution in New York. The Canadian white-footed mouse occurs throughout the extensive Canadian forests in the northern part of the state and in isolated colonies further south, where elevation or dense damp woodland gives it essentially Canadian environment.

Principal records. De Kay and Merriam: The statements by these writers quoted under the northeastern white-footed mouse refer partly to the present species.

Mearns: "The Canadian deer mouse though nowhere abundant was found from the margin of Schoharie creek up to the summit of Hunter mountain and in all sorts of places—sugar camps, deserted houses, deciduous woods, spruce and balsam swamps, under rocks, among the roots of old stumps, in brush heaps, and in open grassy places; in short it was found everywhere, but nowhere in abundance. It was much less common than *Peromyscus leucopus* along Schoharie creek, where both species were sometimes taken in the same spot. When trapped its cheek pouches are as likely to be filled with food as those of the chipmunk. I do not remember ever to have found food in those of *Peromyscus leucopus*" ('98b, p. 350).

This species is abundant at Peterboro, Madison co. and Elizabethtown, Essex co., but I have not met with it elsewhere in New York. In both of these localities it is chiefly a forest mouse, seldom entering the cleared land occupied by *P. leucopus noveboracensis.* In open groves and about the outskirts of heavy woods the two species meet on neutral ground, but in general their ranges are so distinct that it is possible after a little experience to predict which animal will be caught in a particular spot. In the original description of this mouse (Miller, '93b, p. 62) I called attention to the fact, since verified by Dr Mearns, that the cheek pouches are much more freely used by this species than by the northeastern white-footed mouse.

Neotoma pennsylvanica Stone *Cave rat*

1858 *Neotoma floridana* Baird, Mam. N. Am. p. 489 (part).

1893 *Neotoma pennsylvanica* Stone, Acad. nat. sci. Philadelphia. Proc. 21 Feb. 1883. p. 16.

1894 *Neotoma magister* Rhoads, Acad. nat. sci. Philadelphia. Proc. Oct. 1894. p. 213 (not of Baird).

1894 *Neotoma pennsylvanica* Allen, Am. mus. nat. hist. Bul. 22 Dec. 1894. 6:362.

1898 *Neotoma pennsylvanica* Mearns, Am. mus. nat. hist. Bul. 9 Sep. 1898. 10:334.

Type locality. South mountain, Cumberland co. Pennsylvania.

Faunal position. The cave rat is probably an inhabitant of the transition zone, though its peculiar habits make any definite decision a matter of uncertainty. It occurs in many localities within the limits of

the upper austral zone, but such places may prove to be transition 'islands.'

Habitat. Caves, overhanging cliffs and rocky mountain sides.

Distribution in New York. The cave rat is not at present known to occur in New York outside of the lower Hudson valley, though there is reason to believe that it will be found at other localities along the southern border of the state.

Principal records. Baird: "A few specimens of unusually large size were captured some years ago by Mr J. G. Bell near Pierpont on the Hudson river" ('58, p. 489). Allen: "I have now to record the capture of a specimen on Storm King mountain, Cornwall, Orange co. N. Y. about 50 miles north of New York city and 40 miles north of Piermont. . . . The place of capture was at the base of a cliff 30 or 40 feet in height at an elevation of about 1000 feet. The cliff is full of deep crevices and has a talus of loose stones at its base" ('94 b, p. 362).

Remarks. With regard to the relationship of this animal with the fossil species found in the cave deposits of Pennsylvania Dr Mearns writes: "Mr Samuel N. Rhoads in a paper entitled 'A contribution to the life history of the Alleghany cave rat, *Neotoma magister* Baird' ['94], claims that the recent species described by Mr Witmer Stone ['93 b] under the name *Neotoma pennsylvanica* is specifically identical with the subfossil cave species named *Neotoma magister* by Baird ['57, p. 486]. I am unable to concur in this opinion, for the reason that a comparison of eight jaws — one upper and seven lower— belonging to Baird's type series of his *Neotoma magister* differ in important respects from a series of recent skulls . . . of *Neotoma pennsylvanica* Stone. . . In this comparison *Neotoma magister* proves to have been a considerably larger and stouter animal than *N. pennsylvanica*, the skull is relatively shorter . . . the mandibles are deeper . . . the tooth row broader and longer . . . " ('98 a, p. 334–35). I have examined the specimens referred to by Dr Mearns and see no reason to question his conclusion. Remains of *Neotoma magister* are to be looked for in caves and rock fissures in southern New York.

Evotomys gapperi gapperi (Vigors) *Common red-backed mouse*

1830 *Arvicola gapperi* Vigors, Zool. journ., 5: 204.

1841 *Arvicola fulvus* Audubon & Bachman, Acad. nat. sci. Philadelphia. Journ. 5 Oct. 1841. v. 7. pt. 2: 295.

1842 *Arvicola rufescens* De Kay, Zoology of New York, Mammalia. p. 85.

1856 *Arvicola dekayi* Audubon & Bachman, Quadr. N. Am. 3 : 287.
1884 *Evotomys rutilus gapperi* Merriam, Linn. soc. New York. Trans. 2 : 173.
1891 *Evotomys gapperi* Merriam, North American fauna. 30 July 1891. no. 5, p. 119.
1898 *Evotomys gapperi* Mearns, U. S. Nat. mus. Proc. 21 : 349.

Type locality. Region between York and Lake Simcoe, Ontario Canada.

Faunal position. While the common red backed mouse is a typical Canadian animal, in sufficiently cool, damp localities it penetrates considerably to the south of the normal geographic limits of the boreal zone.

Habitat. In the northern part of its range this mouse is found in almost every variety of surroundings, but further south its habitat becomes more limited. In the Canadian zone it is one of the most widely dispersed mammals, in the northern part of the transition zone it is restricted to damp woods, while in the lower part of the transition zone it is never found far away from cold streams, wooded sphagnum bogs and cedar swamps. Mr Charles H. Batchelder has recently described the conditions under which the red-backed mouse occurs in the transition zone of eastern Massachusetts. He says, " What these favorable conditions are, is the most interesting question connected with the animal's [local] distribution, but it is not one that can receive a positive and final answer. Nevertheless there are some characteristic features that are common to almost all of the places where I have found it [in southeastern New England]. One may look for it with some confidence in almost any large tract of wet ground that retains its moisture through the summer, but is not subject to serious floods, and which bears a growth of woods sufficiently heavy to afford a dense shade, so that the ground beneath and the roots of the trees are covered with a deep carpet of sphagnum. If the older trees have been suffered to die a natural death, and their stumps and fallen trunks lie slowly rotting on the ground half-concealed by the sphagnum, the chance of finding it is certainly not lessened. One of the most evident peculiarities of such a spot as this, in southern New England, is that the dense shade and the abundant evaporation maintain a temperature during the hottest summer weather that is far below that of the surrounding country. In these respects of coolness, moisture and shade there is a striking resemblance to the woods *Evotomys gapperi* inhabits in extreme northern New England and other parts of the Canadian zone.

" The places where I have found it differ considerably in their appearance, chiefly according to the kinds of trees with which they are wooded.

In the southern counties the conditions I have named are best afforded by the 'cedar swamps' that once were such a characteristic feature of that part of the state. These are tracts of low ground varying in area from a few acres to sometimes several square miles densely wooded with white cedar (*Chamaecyparis sphaeroidea* Spach). The cedars stand crowded close together each one rising from a hummock formed of its own roots and the mass of sphagnum growing on them. Between the hummocks even in summer the water lies in shallow pools, save where it is covered by a luxuriant growth of the spongy sphagnum. Sometimes here and there in spots where the cedars have opened their ranks and left room enough for other trees to grow, there are a few red maples or white pines, and an occasional yellow birch or stunted black spruce.

"Farther north in Middlesex and Essex counties where these cedar swamps are comparatively few and seldom large, Evotomys often finds its home in swampy woods of old red maples, where the thick foliage of the spreading branches casts a dense shade, sometimes made even darker by an undergrowth of tall shrubs, among which the high-bush blueberry (*Vaccinium corymbosum*) is the chief. Here too sphagnum flourishes, and covers the roots and hummocks that rise a little above the lower levels of the wet ground" ('96a, p. 192–93). What Mr Batchelder says about the habitat of the red-backed mouse in Massachusetts applies equally well to the animal's haunts in New York south of the Adirondacks. Here however dense thickets of arbor vitae (*Thuja occidentalis*) generally replace the 'cedar' swamps.

Distribution in New York. In New York the common red-backed mouse occurs abundantly throughout the Canadian forests. The details of its distribution south of this region are very imperfectly known, but the animal is to be looked for in suitable localities throughout the state.

Principal records. De Kay: "We have little to add except that it was first obtained from low grounds in the neighborhood of Oneida lake. I subsequently found it in great numbers in the forests of Hamilton and St Lawrence counties" ('42, p. 86).

Merriam: "The red-backed mouse is abundant in all parts of the Adirondacks. It occurs on the summits of the tree-covered mountains as well as in the deepest valleys. It is essentially a wood species in its local distribution, rarely frequenting the beaver meadows or the fields of the farmer. It often enters the woodman's camp, and I have sometimes caught it even in the luxurious log-houses which have, during the past few years, supplanted the old-time shanties in many parts of the Adirondacks" ('84d, p. 173).

Mearns: "This mouse was not found on the immediate banks of Schoharie creek although such Canadian forms as *Tamias striatus lysteri*, *Peromyscus canadensis*, *Sorex fumeus*, *and Zapus insignis* were there in abundance. It was met with in woods close to Kaaterskill junction (altitude 1700 feet) and on the lower slopes of East Kill mountain, on the opposite (right) side of Schoharie creek at the level of about 2000 feet. Above these points it increased in abundance until on the summit of Hunter mountain (altitude 4025 feet) it became so numerous that it was difficult to trap any other small mammal there. In the hardwood forests at low altitudes it was usually taken about moss-covered logs and in hollow stumps in dense woods, but on higher ground it was common everywhere" ('98b, p. 349–50).

I have found the common red-backed mouse abundant at Peterboro, Madison co. and Elizabethtown, Essex co.

Mr Savage has not yet taken it in the vicinity of Buffalo.

Evotomys gapperi rhoadsi Stone *New Jersey red-backed mouse*

1893 *Evotomys gapperi rhoadsi* Stone, American naturalist. Jan. 1893. p. 55.

1897 *Evotomys gapperi rhoadsi* Bailey, Biolog. soc. Washington. Proc. 11:125.

1898 *Evotomys gapperi rhoadsi* Mearns, Am. mus. nat. hist. Bul. 9 Sep. 1898. 10:333.

1898 *Evotomys gapperi rhoadsi* Mearns, U. S. Nat. mus. Proc. 21:350.

Type locality. May's landing, New Jersey.

Faunal position. This animal is at present known to occur in cool, probably boreal localities in the transition zone.

Habitat In New Jersey this mouse occurs in cranberry bogs near the coast (Stone, '93, p. 55–56). In New York it has been found in a sphagnum bog overgrown with spruce and tamarack.

Distribution in New York. At present the only known locality at which this animal occurs in New York is in the higher part of the Hudson highlands.

Principal records. The only record of *Evotomys gapperi rhoadsi* in New York is the following in Dr Mearns's paper on the Mammals of the Catskills. "Farther south, in the Hudson highlands, only the subspecies *rhoadsi* was found. It occurred in sphagnous swamps overgrown with black spruce and tamarack in the highest part of the mountains, where a single immature specimen was trapped September 30, 1896.

This individual, which I have compared with topotypes of *Evotomys gapperi rhoadsi* in the department of agriculture collection, appears to be of this form. The specimen (No. 82,832 U. S. N. M.) shows very little of the red dorsal area, the back being brownish gray as described by Mr Stone and quite unlike any of the Catskill specimens" ('98b, p. 350).

Remarks. This record appears to me open to serious question, though under the circumstances I see no other course than to include it as it stands.

Microtus chrotorrhinus (Miller) *Rock vole*

1894 *Arvicola chrotorrhinus* Miller, Boston soc. nat. hist. Proc. 24 Mar. 1894. 21:190.

1896 *Microtus chrotorrhinus* Bangs, Biolog. soc. Washington. Proc. 9 Mar. 1896. 10:49.

1898 *Microtus chrotorrhinus* Mearns, U. S. Nat. mus. Proc. 21:349.

Type locality. Mount Washington, New Hampshire.

Faunal position. The rock vole is so slightly known that its faunal position can not now be definitely stated. Apparently it is a member of the Hudsonian fauna, reaching the Canadian zone in the coldest situations only.

Habitat. Damp, heavy spruce woods in the Hudsonian zone (Allen, '94a, p. 102, Bangs, '96b, p. 49), cold rock cavities in the Canadian zone (Miller, '94, p. 192–93, Batchelder, '96a, p. 188). Batchelder thus describes the habitat of this animal at Beedes, Essex co., New York: "This place was a steep hillside heavily wooded with an old mixed growth. The lower slopes were made up of a talus of large angular blocks of rock piled one upon another as they had fallen from the cliffs above. The damp rocks were covered with sphagnum and ferns, and from the holes and spaces between them came currents of cold air, indicating the presence of masses of yet unmelted ice somewhere in the depths below. . . . I trapped for two days at the foot of another talus . . . Here the huge rocks gave little foothold for the large trees, but the masses of ice beneath, of which glimpses could be had here and there, in the caverns between the rocks, aided by the shade afforded by a wall of mountain, produced a temperature so low that spring flowers blossomed even in August among the deep beds of damp sphagnum that covered the rocks" ('96a, p. 188).

Distribution in New York. The rock vole has been found at only two localities in New York, at Beedes, Essex co. and on Hunter mountain in the Catskills. It probably occurs among the mountains of the

northern part of the state wherever the requirements of its Hudsonian nature are met.

Principal records. Batchelder: "At Beedes, Essex co. N. Y. late in the summer of 1894 . . . I made . . . the very unexpected discovery that *Microtus chrotorrhinus* was common there, at least in one particular locality" ('96a, p. 188). Mearns: "One adult male was trapped in a pile of moss-covered rocks on a shoulder of Hunter mountain, at an altitude of about 3500 feet, August 25, 1896. Many traps were subsequently placed about this spot, but no others were caught" ('98, p. 349).

Microtus pennsylvanicus (Ord) *Common meadow mouse*

1815 *Mus pennylvanicus* Ord, Guthrie's geography. Am. ed. 2 p. 292.
1825 *Arvicola riparius* Ord, Acad. nat. sci., Philadelphia journ. v. 4 pt. 2, p. 305, 1825.
1842 *Arvicola riparius* De Kay, Zoology of New York, Mammalia. p. 84.
1842 *Arvicola hirsutus* De Kay, Zoology of New York, Mammalia. p. 86.
1842 *Arvicola oneida* De Kay, Zoology of New York, Mammalia. p 88.
1842 *Arvicola xanthognathus* De Kay, Zoology of New York, Mammalia. p. 90.
1884 *Arvicola riparius* Merriam, Linn. soc. New York. Trans. 2 : 174.
1895 *Microtus pennsylvanicus* Rhoads, American naturalist. Oct. 1895. 29 : 940.
1896 *M[icrotus] pennsylvanicus* Fisher, The Observer. May 1896. 7 : 198.
1898 *Microtus pennsylvanicus* Mearns, Am. mus. nat. hist. Bul. 9 Sep. 1898. 10: 333.
1898 *Microtus pennsylvanicus* Mearns, U. S. Nat. mus. Proc. 21 : 348.

Type locality. Near Philadelphia, Pa.

Faunal position. The common meadow mouse ranges from well within the Canadian zone nearly to the northern edge of the lower austral zone. In the Hudsonian zone it is replaced by a smaller soft-furred race *Microtus pennsylvanicus fontigenus* (Bangs, '96b, p. 48, Miller, '97b, p. 14), and in the upper part of the upper austral zone by a much darker form *M. pennsylvanicus nigrans* (Rhoads, '97d, p. 307).

Habitat. Open, grassy places both wet and dry.

Distribution in New York. The meadow mouse is one of the most abundant mammals throughout the cleared portions of the state. Its range has undoubtedly been very much extended by the removal of the forests, and consequent increase in the area of grass lands.

Principal records. DeKay: "The marsh meadow-mouse is not uncommon in various parts of the state. I have seen specimens from Oneida, Seneca and Otsego counties" ('42, p. 85 under *Arvicola riparius*). "It occurs in various parts of the state" ('42, p. 88 under *Arvicola hirsutus*). "This species is common in the western part of the state. My specimens were obtained from the neighborhood of Oneida lake" ('42, p. 89, under *Arvicola oneida*). "This meadow-mouse is found in various parts of the state" ('42, p. 90 under *Arvicola xanthognathus*).

Merriam: "The meadow mouse is common in the cleared lands within and around the Adirondack region. It occurs on many of the beaver meadows, but is never abundant in the coniferous forests" ('84d, p. 174).

Fisher: "Very common in the low wet meadows especially near streams" ('96, p. 198).

Mearns: "Specimens were taken from fields bordering Schoharie creek (altitude 1700 feet) and on the ridge of Hunter mountain at an altitude of 3900 feet" ('98, p. 348).

I have found the meadow mouse abundant at Geneva, Ontario co. Peterboro, Madison co. and Elizabethtown, Essex co.

Mr Savage reports the species abundant in Erie co. Mr Helme writes, "This animal is found quite plentifully in the upland fields of Long Island, but is more abundant around the marshes and salt meadows."

Remarks. Although the meadow mouse is popularly considered one of the worst farm pests, Mr Samuel N. Rhoads has recently published a lengthy vindication of the animal ('98 a, p. 143-44 and '98 b, p. 571-81).

Microtus nesophilus Bailey *Gull Island mouse*

1889 *Arvicola riparius* Dutcher, Auk. Ap. 1889. 6:125.

1898 *Microtus insularis* Bailey, Biolog. soc. Washington. Proc. 30 Ap. 1898. 11:86 (not *Lemmus insularis* Nilsson, Ofversigt af Kongl. Vetenskaps-Akademiens Förhandlingar, Årg. 1, 20 Mar. 1844. 34).

1898 *Microtus nesophilus* Bailey. Science, N. S. 2 Dec. 1898. 8:783.

Type locality. Great Gull Island, Long Island, New York.

Faunal position. Transition zone.

Distribution in New York. This species was confined to two small islands in Long Island sound, off the extreme northeastern point of Long Island, Little Gull Island and Great Gull Island. It is now probably extinct as shown by the following notes kindly furnished by Mr Arthur H. Howell: "On August 8, 1898 in company with Mr A. H.

Helme I visited Great Gull Island for the purpose of learning the condition of the colony of meadow mice that formerly existed there. Careful search on every part of the island for signs or runways of the mice failed to reveal any indication whatever of their presence. The natural conclusion is that the race has been nearly if not quite exterminated. The cause is not difficult to see. Within the past year the island, which contains only about 15 acres, has been occupied by the United States government as a coast defence station, and the construction of forts at each end of the island has necessitated disturbances of the soil and change in the topography of practically the whole surface. The forts themselves with the shanties erected for the use of the laborers cover a considerable portion of the island, hills have been levelled, the little fresh water swamp has been filled in, and the whole surface twice burned over. The destruction of all the rubbish and dead vegetation deprived the mice of any cover where they could seek shelter, and the sparseness of the new growth made it easy for us to examine every available hiding place. Doubtless any of the mice which may have escaped the fires were captured by the cats which roam at will over the island.

"On the same day we visited Plum island, situated between Great Gull Island and the eastern end of Long Island. Here we found *Microtus* quite abundant about the edges of the swamps on the western end of the island, and a series of 14 was secured. Comparison of these specimens with the mainland form shows that the Plum island mouse is like the latter and entirely different from *Microtus nesophilus*."

Principal records. The first published record of this mouse is contained in a paper by Dr Basil Hicks Dutcher on the birds of Little Gull Island ('89). Dr Dutcher says, "Great Gull Island was purchased by the Government to serve as a garden for the keepers of the Little Gull Light, but it was so overrun with mice that it was useless for the purpose. . . . I secured one specimen of the resident mouse, which proved to be a juvenile *Arvicola riparius*." This specimen afterward became Mr Bailey's type of *Microtus insularis*. Mr J. Harris Reed has recently described in considerable detail the fortifications on Great Gull Island and their effect on the fauna of the place ('98, p. 41–43).

Mr Frank M. Chapman informs me that he visited Great Gull Island during the summer of 1889. He found the mouse colony in the same flourishing condition described by Dr Dutcher. Seven specimens which he collected are now in the American museum of natural history.

Microtus pinetorum scalopsoides (Audubon and Bachman)

Northern pine mouse

1841 *Arvicola scalopsoides* Audubon and Bachman, Acad. nat. sci. Philadelphia. Proc. 1 : 97.

1851 *Arvicola pinetorum* Audubon and Bachman, Quadr. N. Am. 2 : 216.

1885 *Arvicola pinetorum* Merriam, American naturalist. 19 : 895.

1896 *Microtus pinetorum* Fisher, The Observer. May 1896. 7 : 198.

1896 *Microtus pinetorum scalopsoides* Batchelder, Boston soc. nat. hist. Proc. Oct. 1896. 27 : 187.

Type locality. Long Island.

Faunal position. Upper austral zone, and irregularly parts of transition zone.

Habitat. Light dry soil in woods, thickets and fields.

Distribution in New York. The pine mouse is abundant on Long Island and in the lower Hudson valley. Beyond this general region I know of but two positive records of its occurrence, at Locust Grove, Lewis co. and at Peterboro, Madison co.

Principal records. Audubon and Bachman: "This species, of which we have obtained many specimens from Long Island, and which is not rare in the vicinity of New York, is very distinct from Wilson's meadow mouse" ('41, p. 97). Merriam: "On the 13th of June, 1884 at my home in Lewis county, New York, I caught a female pine mouse (*Arvicola pinetorum* Le Conte). It was taken in a trap baited with beechnuts and set for the red-backed wood mouse (*Evotomys rutilus gapperi*) at the roots of a maple in the border of a hardwood forest" ('85, p. 895). Fisher, "Until the present year [1885] we have never detected the pine mouse (*Arvicola pinetorum*) in this locality [Sing Sing]" ('85, p. 896). "Tolerably common [at Sing Sing]. Its favorite resorts are the dry grassy hillsides more or less grown up with small bushes and briers, and old orchards containing weeds, matted grass, and young saplings" ('96, p. 198).

I have taken two specimens of the pine mouse at Peterboro, Madison co. One of these was caught September 15, 1892 in a cyclone trap set without bait in a labyrinth of short-tailed shrews' tunnels in the edge of a grove of hard wood. The other, taken September 1, 1893, was secured with a cyclone trap set in a woodchuck's burrow beneath the roots of a large elm in a low, damp wood lot. I have never seen the characteristic, mole-like tunnels of the pine mouse at Peterboro where

the animal is probably a mere straggler. Mr Savage has not yet found the pine mouse in Erie co., where however it doubtless occurs. Mr Helme writes that it is abundant in the dry upland fields and woods of Long Island.

Fiber zibethicus (Linnaeus) *Muskrat*

1766 *Castor zibethicus* Linnaeus, Systema naturae. ed. 12. 1 : 79.
1817 *Fiber zibethicus* Cuvier, Règne animal. 1 : 192.
1842 *Fiber zibethicus* De Kay, Zoology of New York, Mammalia. p. 75.
1884 *Fiber zibethicus* Merriam, Linn. soc. New York. Trans. 2 : 177.
1896 *Fiber zibethicus* Fisher, The Observer. May 1896. 7 : 198.
1898 *Fiber zibethicus* Mearns, Am. mus. nat. hist. Bul. 9 Sep. 1898. 10 : 332.
1898 *Fiber zibethicus* Mearns, U. S. Nat. mus. Proc. 21 : 348.

Type locality. Eastern Canada.

Faunal position. As the muskrat is essentially an aquatic animal its distribution is not limited by the same climatic conditions that govern the ranges of most mammals. It is therefore at present impossible to assign the animal any definite faunal position. The difficulty is increased by the fact that little is known of the geographic variations to which the species may be subject. Muskrats range through all the life zones from Hudsonian to lower austral inclusive.

Habitat. Marshes and the borders of lakes, ponds and sluggish streams.

Distribution in New York. There are probably very few square miles of the state in which the muskrat does not now occur. This is probably one of the few mammals whose range has not been sensibly increased or diminished by the clearing and settling of the state.

Principal records. De Kay: "The geographic range of the musquash is very extensive, being found from 30° to 69° north latitude" ('42, p. 76). Merriam: "Colonies of muskrats may be found at suitable ponds, swamps and sluggish streams in all parts of the Adirondacks" ('84d p. 177). Fisher: "Common [near Sing Sing] in the salt meadows, tide creeks and all the streams and ponds" ('96, p. 198). Mearns: "The muskrat is abundant at Kaaterskill lake. It is also said to occur along Schoharie creek, but we saw no signs of it there" ('98, p. 348).

I have found the muskrat common at Geneva, Ontario co. Peterboro, Madison co. and Elizabethtown, Essex co. Mr Savage writes, "The muskrat is abundant locally [in Erie co.]. During a recent flood in

South Buffalo (January 6, 1898) an acquaintance of mine with two companions secured 54 rats along the railroad embankments within the city limits, and another person shot 18 in the same section." Of the muskrat on Long Island Mr Helme says, "It is common in all sections where there are suitable ponds, swamps or streams. It occasionally is found in the salt marshes."

Synaptomys cooperi Baird *Bog lemming*

1858 *Synaptomys cooperi* Baird, Mam. N. Am. p. 558.

1896 *Synaptomys cooperi* Batchelder, Boston soc. nat. hist. Proc. 27 : 185.

Type locality. Northern New Jersey?

Faunal position. The bog lemming is probably a Canadian mammal, but it occurs in cold situations throughout the transition zone and even in the northern edge of the upper austral zone.

Habitat. Cold bogs, either wooded or open.

Distribution in New York. While *Synaptomys cooperi* probably occurs in nearly every county of the state, it has as yet been taken in only two localities, Beedes, Essex co. and Glenwood, Erie co.

Principal records. Batchelder: "In the summer of 1895 I was surprised to find this species in the Adirondack mountains at Beedes, Essex co. N. Y. On August 16 I set 36 'cyclone' traps baited with rolled oatmeal in some low ground, wooded chiefly with large yellow birches, sugar maples and beeches, with more or less thin, tall undergrowth (chiefly *Acer spicatum* Lam. and *A. pennsylvanicum L.*), and with many mossy rotten logs and stumps scattered over it. A dozen of the traps were along the edge of some wetter, almost swampy, ground where more of the larger trees had been cut and there was a thick growth of small trees, chiefly *Acer spicatum*. Two days later, August 18, I found an adult male *Synaptomys cooperi* caught in a trap set at the foot of a large rotten stump in the edge of the swampy ground. Three days later I caught an immature female near by, also in the edge of the swampy ground, in a trap placed under a rotten log. Two days after this I got still a third, another adult male, this time in the open drier part of the woods 30 or 40 yards from the wet ground" ('96a, p. 185).

Mr Savage has sent me for examination the skin and skull of a *Synaptomys cooperi* that he shot at Glenwood, Erie co. December 31, 1897. When killed the animal was running in a sleigh track in the woods. The specimen is not fully mature but I have little hesitation in referring it to this species.

Synaptomys fatuus Bangs *Northern bog lemming*

1896 *Synaptomys fatuus* Bangs, Biolog. soc. Washington. Proc. 10 : 47.
1898 *Synaptomys fatuus* Mearns, U. S. Nat. mus. Proc. 21 : 348.

Type locality. Lake Edward, Quebec.

Faunal position. *Synaptomys fatuus* appears to be a member of the Hudsonian fauna, entering the normal area of the Canadian zone in very cold situations only.

Habitat. Bogs and damp woodlands.

Distribution in New York. The northern bog lemming has been taken only once in New York, near the summit of Hunter mountain in the Catskills.

Principal records. Mearns: "A single specimen of this species was trapped near the summit of Hunter mountain, the locality being a marshy place strewn with fallen trees at the altitude of 3900 feet." ('98, p. 348).

Remarks. The occurrence of this Hudsonian species in the Catskills is very unexpected, and further material to verify the identification of the Catskill animal is greatly to be desired. This peculiar distribution is however very closely paralleled by that of *Microtus chrotorrhinus*.

Zapus hudsonius (Zimmermann) *Meadow jumping-mouse*

1780 *Dipus hudsonius* Zimmermann, Geogr. Gesch. 2 : 358.
1842 *Meriones americanus* De Kay, Zoology of New York, Mammalia, p. 70.
1872 *Zapus hudsonius* Coues, U. S. Geol. and geogr. surv. terr. Bul. ser. 2. no. 5. p. 254.
1884 *Zapus hudsonius* Merriam, Linn. soc. New York. Trans. 2 : 192 (part).
1896 *Zapus hudsonicus* Fisher, The Observer. May 1896. 7 : 198.
1898 *Zapus hudsonius* Mearns, U. S. Nat. mus. Proc. 21 : 347.
1898 *Zapius hudsonius* Mearns, Am. mus. nat. hist. Bul. 9 Sep. 1898. 10 : 332.

Type locality. Hudson bay.

Faunal position. Hudsonian, Canadian and transition zones.

Habitat. Meadows, damp brushy fields, the edges of woodlands and marshes bordering northern lakes. Wherever the animal occurs it seeks the most open, grassy situations available.

Distribution in New York. The meadow jumping-mouse occurs in favorable localities throughout New York state. Its range has doubtless been greatly extended, or rather the amount of land suited to its needs has been greatly increased by the clearing away of the forests.

Principal records. De Kay: "This curious little animal although rarely seen, is not uncommon in every part of the state" ('42, p. 71). Merriam: "The jumping-mouse is common in many parts of the Adirondacks as well as in the surroundlng country" ('84d, p. 192). Fisher: "Tolerably common. Usually found in the tall grass of wet meadows near streams, but occasionally observed in dry pastures" ('96, p. 198). Mearns: "Abundant along Schoharie creek, but not found elsewhere in the [Catskill] region" ('98, p. 347).

I have found the meadow jumping-mouse abundant at Peterboro, Madison co. where it never penetrates the dense woods inhabited by *Napaeozapus insignis*. The two species frequently occur together however in thinly wooded places. About this animal in Erie co. Mr Savage writes as follows: "With all my rambling about I never met with *Zapus*, but have heard of it from persons qualified to distinguish it from the white-footed mouse." Mr E. M. Chamot in a letter from Ithaca March 15, 1896 writes me that he once took a specimen of *Zapus* in deep woods at Angola, Erie co. May it not have been *Z. insignis*? Mr Helme reports the meadow jumping-mouse fairly common on Long Island.

Remarks. De Kay figures this species ('42, pl. 24) and his account evidently refers wholly to it. Merriam on the other hand includes both meadow and woodland animals under the name *husdonius*.

I once saw a remarkable demonstration, though a negative one, of the function of the exceedingly long tail of this animal. A young individual had lost its tail by the knife of a mowing machine in a damp meadow and was rendered thereby helpless. Not that its jumping power was in any way impaired, on the contrary I have seldom seen a mouse of the size leap more energetically or to greater distances. But the animal had lost all control over its movements. When I approached, it made violent efforts to escape, but the moment it was launched in air, its body, deprived of its balancing power, turned end over end so that it was as likely as not to strike the ground facing the direction from which it had come. The next frantic leap would then carry it back to the starting point. An animal thus deprived of its tail would be an interesting subject for observation. I am inclined to believe that the lost coordination of movements would eventually be restored.

Napaeozapus[a] **insignis** Miller *Woodland jumping-mouse*

1884 *Zapus hudsonius* Merriam, Linn. soc. New York. Trans. 2:192 (part).
1891 *Zapus insignis* Miller, American naturalist. Aug. 1891. 25:743.

[a] Characterized (as a subgenus) by Preble, North American fauna No. 15, p. 33. August 8, 1899.

1893 *Zapus insignis* Miller, Biolog. soc. Washington. Proc. 22 Ap. 1893. 8:1.

1898 *Zapus insignis* Mearns, U. S. Nat. mus. Proc. 21:348.

Type locality. Restigouche river, New Brunswick.

Faunal position. The woodland jumping-mouse is an inhabitant of the Canadian zone, reaching the transition zone in 'boreal islands' only.

Habitat. Forests and woodlands, specially in the neighborhood of running water.

Distribution in New York. The woodland jumping-mouse probably occurs throughout the Adirondack wilderness and in isolated colonies in other parts of the state wherever the fauna has a distinctly Canadian tinge. At present however it has been recorded from the following localities only: Keene, Essex co. (Miller, '93a, p. 1), Elizabethtown, Essex co. (Miller, '93a, p. 1), Peterboro, Madison co. (Miller, '93a. p. 1) and the Catskills (Mearns '98, p. 348). There is a specimen in the U. S. National museum taken at Glenville, Schenectady co. by P. M. Van Epps. Settlement of the county has probably restricted the range of *Napaeozapus* to nearly the extent that it has increased that of true *Zapus*.

Erethizon dorsatus (Linnaeus) *Canada porcupine*

1758 *Hystrix dorsatus* Linnaeus, Syst. nat. ed. 10. 1:56.

1822 *Erethizon dorsatus* F. Cuvier, Mem. du mus. d'hist. nat. Paris. 9:432.

1842 *Hystrix hudsonius* De Kay, Zoology of New York, Mammalia. p. 77.

1884 *Erethizon dorsatus* Merriam, Linn. soc. New York. Trans. 2:202.

1898. *Erethizon dorsatus* Mearns, U. S. Nat. mus. Proc. 21:346.

Type locality. Eastern Canada.

Faunal position. Boreal and transition zones.

Habitat. Heavy forests.

Distribution in New York. The porcupine is common throughout the Adirondacks and in the Catskills. In other parts of the state it probably occurs wherever there are sufficiently extensive tracts of unbroken forest.

Principal records. De Kay: "In this state more particularly in the northern and western counties they are quite numerous" (42, p. 79). Merriam: "The porcupine is a common and well known resident of all the wooded parts of the Adirondacks" ('84, p. 202). Mearns: "This

remarkable beast was formerly abundant throughout this region [the Catskills]. During recent years it has become comparatively scarce except on the mountains. The skeleton of a porcupine was found under the fallen ruins of an observatory on the summit of Hunter mountain; two other specimens were subsequently trapped there (altitude 4025 feet); three were taken at a spring under a shelving rock, at the altitude of 3800 feet, and a seventh was overtaken and killed in the slide rock on the side of Hunter mountain at about 3000 feet altitude" ('98, p. 346). Lucas ('82, p. 7) records a specimen taken near Rochester, Genesee co. in 1881.

There is a porcupine in the New York state museum taken at McKownville, Albany co.

Mr Savage writes as follows of the occurrence of the porcupine near Buffalo, "The porcupine is to be found in the wilder parts of the southern tier of counties. I have seen a fine big male from near Cherry creek, Chautauqua co. My friend Roger Fitch has shot it near Westfield in the same county. In the fall of 1894 one was brought into Gowanda, Erie co. by a squirrel hunter. I also saw one in August or September, 1896, that had been killed by boys at Blasdell six miles from Buffalo."

Lepus floridanus mallurus (Thomas) *Southeastern cottontail*

1837 *Lepus sylvaticus* Bachman, Acad. nat. sci. Philadelphia. Journ. 7 pt. 2: 403 (part). Not *Lepus borealis sylvaticus* Nilsson. 1832.

1842 *Lepus nanus* De Kay, Zoology of New York, Mammalia. p. 94 (part).

1895 *Lepus sylvaticus* Bangs, Boston soc. nat. hist. Proc. 26: 405.

1896 *Lepus sylvaticus* Fisher, The Observer. May 1896. 7: 198.

1898 *Lepus sylvaticus* Mearns, Am. mus. nat. hist. Bul. 9 Sep. 1898. 10: 331.

1898 *Lepus nuttalli mallurus* Thomas, Ann. and Mag. nat. hist. ser. 7 Oct. 1898. 2: 320.

1899 *Lepus floridanus mallurus* Allen, Am. mus. nat. hist. Bul. 4 Mar. 1899. 12: 13.

Type locality. Raleigh, North Carolina.

Faunal position. Upper and lower austral zones.

Habitat. "*Lepus sylvaticus* lives in the open fields and broom-grass stretches, in the rank growth of weeds along 'creeks', and in the open southern woods, seldom if ever living in the denser parts of woods or swamps" (Bangs, '95, p. 412).

Distribution in New York. The southern cottontail barely reaches the southeastern extremity of New York.

Principal records. Bangs: Specimens recorded from Hastings, Oswego co. and South Nyack, Rockland co. ('95, p. 411). Fisher: "Common [at Sing Sing]. Although hundreds are killed every winter nevertheless they appear to be just as common at the present time as 20 years ago" ('96, p. 198). Mearns: "Fairly common throughout the [Hudson] highlands and found everywhere, from the brackish marshes beside the Hudson to the tops of the highest mountains. Some individuals, those from the highest localities, verge towards the subspecies *transitionalis* of Bangs, which is the only form of this species found about Fort Miller 150 miles higher up the Hudson in Washington co. N. Y." ('98a, p. 331).

I have never met with this rabbit in New York, but Mr A. H. Howell and Mr A. H. Helme have shown me specimens from Long Island. Mr Helme's specimens have been identified by Mr Outram Bangs.

Lepus floridanus transitionalis (Bangs) *Northeastern cottontail*

1837 *Lepus americanus* Bachman, Acad. nat. sci. Philadelphia. Journ. v. 7, pt. 2. p. 326 (part).

1837 *Lepus sylvaticus* Bachman, Acad. nat. sci. Philadelphia. Journ. v. 7, pt. 2. 7 : 403 (part).

1842 *Lepus nanus* De Kay, Zoology of New York, Mammalia. p. 94 (part).

1884 *Lepus sylvaticus* Merriam, Linn. soc. New York. Trans. 2 : 213 (part).

1895 *Lepus sylvaticus transitionalis* Bangs, Boston soc. nat. hist. Proc. 26 : 405.

1898 *Lepus nuttalli transitionalis* Thomas, Ann. and Mag. nat. hist. Oct. 1898. ser. 7. 2 : 320.

1898 *Lepus sylvaticus transitionalis* Mearns, U. S. Nat. mus. Proc. 21 : 345.

1899 *Lepus floridanus transitionalis* Allen, Am. mus. nat. hist. Bul. 4 Mar. 1899. 12 : 13.

Type locality. Liberty Hill, New London co. Ct.

Faunal position. The northeastern cottontail appears to be strictly confined to the transition zone.

Habitat. "*Lepus sylvaticus transitionalis* . . . is seldom found in open fields but prefers the seclusion of the thickest swamps, green brier

patches, scruboaks and old overgrown pastures that have come up to sumacs, alders, roses and various shrubs" (Bangs, '95, p. 412).

Distribution in New York. The distribution of this form of cottontail in New York is very imperfectly understood. The animal probably occurs throughout the area occupied by the transition zone in the eastern half of the state. Without much question it is rapidly pushing its way northward as the heavy forests are removed.

Principal record. Bachman: "About 30 years ago it was not known in the neighborhood of Troy, in the state of New York. The northern hare was then very abundant. The American hare soon after made its appearance in very small numbers and in proportion to its increase the former began to grow more scarce. For a time they continued to be found in the same neighborhood, but whether the two species were not reconciled to each other, or what is more probable, that the northern hare was more hunted than the other, it has become comparatively scarce whilst the American hare is exceedingly numerous" ('37a, p. 328). De Kay: "It has not a wide geographic range. It is found from New Hampshire to Florida but its western limits are not yet established" ('42, p. 95). Merriam: "The gray rabbit . . . only enters the Adirondack region along its southern border, in Fulton, Saratoga and Warren counties" ('84d, p. 213). Bangs: "East side of lower Hudson river" ('95, p. 411). Fisher: "Common [at Sing Sing]" ('96, p. 198). Mearns: "Curiously enough this small rabbit is generally known to the residents of the upper Schoharie valley by the name of 'Jack rabbit'. I was informed by persons who had lived near Kaaterskill junction for many years that this rabbit had extended its range upward into the cleared lands of the Schoharie valley during recent years" ('98b, p. 345).

Lepus floridanus mearnsi Allen *Eastern prairie cottontail*

1894 *Lepus sylvaticus mearnsi* Allen, Am. mus. nat. hist. Bul. 31 May 1894. 6: 171.

1895 *Lepus sylvaticus mearnsi* Bangs, Boston soc. nat. hist. Proc. 26: 406.

1898 *Lepus nuttalli mearnsi* Thomas, Ann. and Mag. nat. hist. Oct. 1898. ser. 7. 2: 320.

1899 *Lepus floridanus mearnsi* Allen, Am. mus. nat. hist. Bul. 4 Mar. 1899. 12: 13.

Type locality. Fort Snelling, Minnesota.

Faunal position. Transition and upper austral zone.

Habitat. Prairies and open fields.

Distribution in New York. The eastern prairie cottontail probably occurs throughout the western half of New York. The only published record of its presence in the state rests however on two specimens from Peterboro, Madison co (Bangs, '95, p. 406). The animal has undoubtedly extended its eastward range very rapidly during the past 50 years as the clearing away of the heavy forests has increased the area suited to its needs (Miller, '95a, p. 410). Mr Savage writes that cottontails are common near Buffalo. From measurements which he sends me of six specimens shot at Cherry creek, Chautauqua co. in January 1898, I think there can be no doubt that the form occurring there is *Lepus floridanus mearnsi.*

Lepus americanus virginianus (Harlan) *Southern varying hare*

1825 *Lepus virginianus* Harlan, Fauna Americana. p. 196.

1842 *Lepus americanus* De Kay, Zoology of New York, Mammalia. p. 95.

1877 [*Lepus americanus*] var. *virginianus* Allen, Monogr. N. Am. Rodentia. p. 307.

1884 *Lepus americanus* Merriam, Linn. soc. New York. Trans. 2:207.

1884 *Lepus americanus virginianus* Merriam, Linn. soc. New York. Trans. 2:211.

1898 *Lepus americanus virginianus* Bangs, Biolog. soc. Washington. Proc. 12:79.

1898 *Lepus americanus virginianus* Mearns, U. S. Nat. mus. Proc. 21:346.

Type locality. Blue mountain of Pennsylvania.

Faunal position. The southern varying hare is an inhabitant of the boreal zone, penetrating the limits of the transition zone in specially favorable localities only. "That it has a weak hold upon a place in the fauna of the transition zone is shown by the rapidity with which it disappears when the conditions that enabled it to exist there are slightly changed" (Bangs, '98, p. 81).

Habitat. Damp, cool woods and forests.

Distribution in New York. This animal occurs throughout the northern part of the state, and in suitable isolated localities farther south where it has not yet been exterminated. It is one of the species whose range has been greatly restricted by the clearing away of the heavy forests.

Principal records. De Kay: "It occurs in most parts of the state and is often called the white rabbit. In the winter the markets of New York are abundantly supplied with this species from the Kaaterskill and Shawangunk (Shongo) mountains" ('42, p. 96). Merriam: "The northern hare is found in greater or less abundance in most parts of the Adirondacks" ('84d, p. 207). Mearns: "This hare is abundant on the

summits of East Kill, Plateau and Hunter mountains, descending at times along belts of coniferous trees nearly to Schoharie creek. In the lowest country it is said to be almost wholly replaced by the cottontail" ('98b, p. 346).

I have found the southern varying hare locally common at Peterboro, Madison co. and abundant at Elizabethtown, Essex co. Of the occurence of this species near Buffalo, Mr Savage writes: "The varying hare is becoming rare or local. On December 8, 1897 I saw four on R. & P. r. r. train that were shot at West Valley, Cattaraugus co. Also heard of their being taken near Java, Wyoming co. in the autumn of 1897. On January 29, 1898, one was shot near Cherry creek, Chautauqua co.

Remarks. The northern varying hare *Lepus americanus americanus* Erxleben was formely supposed to occur in New York (see Merriam, '84d, p. 207) but Bangs has recently shown that the southern boundary of its range does not reach the northern edge of the United States ('98, p. 78).

Felis oregonensis hippolestes (Merriam) *Northeastern panther*

1842 *Felis concolor* De Kay, Zoology of New York, Mammalia. p. 47.
1882 *Felis concolor* Merriam, Linn. soc. New York. Trans. p. 1 : 29.
1897 *Felis hippolestes* Merriam, Biolog. soc. Washington. Proc. 11 : 219. 15 July 1897.
1899 *Felis oregonensis hippolestes* Stone, Science, N. S. 9: 35. 6 Jan. 1899.

Type locality. Wind River mountains, Wyoming.

Faunal position. The northeastern panther was formerly an inhabitant of the Canadian, transition and upper austral zones. It is now exterminated in all but the first named.

Habitat. Forests.

Distribution in New York. This animal still exists in the wilder portions of the Adirondacks. Elsewhere it is extinct within the limits of the state.

Principal records. DeKay: "In this state the panther is most numerous in the rocky northern districts and particularly in the counties of Herkimer, Hamilton and St Lawrence. They are occasionally seen among the Kaaterskill mountains, and the specimen in the New York museum . . . was obtained from this locality" ('42, p. 48). Merriam: "It is not many years since the cougar or panther, second largest of American *Felidæ*, was a common inhabitant of the primeval forests of the Adirondacks; but since the state offered a bounty [in 1871] for their destruction so many more have been killed than born that they are now

well nigh exterminated. However a few still remain and some years may yet elapse before the last panther disappears from the dense evergreen swamps and high rocky ridges of this wilderness" ('82 p. 29–30).

Remarks. I use the subspecific name *hippolestes* for the northeastern panther as the least unsatisfactory course at present open.

The data from which the following table of panther bounties has been prepared are furnished by Dr Frederick J. H. Merrill.

Table of bounties paid for panthers in New York under law of 1871

County	Town	Date	By whom killed	Amount paid
Essex	Newcomb	10 N 1871	J. C. Fanner..........	$20
"	"	11 D 1871	"	20
"	"	"	"	20
"	"	"	"	20
"	"	25 F 1880	W. H. Cullen	20
"	Wilmington	14 Jl 1883	Arthur Croninshield and J. C. Sanders...	20
"	"	11 Ag 1883	" ...	20
"	"	14 Ag 1888	James Jagins	20
Franklin	Dickinson	4 D 1872	M. H. Ober	20
"	"	29 Ag 1873	C. A. Merrill	20
Hamilton	Lake Pleasant...	29 F 1872	A. B. Sturges & B. Page	20
"	Long Lake	29 F 1878	J. W. Schultz.........	20
"	"	21 Je 1882	George Muir	20
"	"	"	"	20
"	"	22 Jl 1882	"	20
"	"	24 Jl 1882	"	20
"	"	10 S 1882	"	20
"	"	28 O 1883	"	20
"	"	"	"	20
"	"	30 N 1883	"	20
"	"	5 F 1887	"	20
"	"	8 F 1887	"	20
"	Wells	19 D 1876	Silas Call	20
Herkimer	Wilmurt.........	11 D 1877	E. L. Sheppard	20
"	"	12 D 1877	"	20
"	"	13 D 1877	"	20
"	"	26 F 1878	E. N. Arnold..........	20
"	"	8 Mar 1878	"	20
"	"	26 D 1878	A. S. Marshall	20
"	"	"	"	20
"	"	25 O 1882	George Muir	20
"	"	30 N 1882	"	20
"	"	10 My 1883	"	20
"	"	"	"	20
"	"	2 Ag 1883	"	20
"	"	"	"	20
"	"	8 Ja 1884	"	20
"	"	19 Ja 1884	"	20
Lewis	Croghan	20 N 1882	"	20
"	"	25 Je 1883	"	20
"	"	29 F 1884	"	20
"	Diana	23 My 1882	"	20
"	"	10 Je 1882	"	20
"	"	28 Je 1882	"	20
"	"	13 Jl 1882	"	20
"	"	18 Ag 1882	"	20
"	"	"	"	20

Table of bounties paid for panthers in New York under law of 1871, continued

County	Town	Date	By whom killed	Amount paid
Lewis	Diana	14 My 1883	George Muir	$20
"	"	5 Je 1883	"	20
"	"	12 Jl 1883	"	20
"	"	"	"	20
"	"	5 F 1884	"	20
"	"	"	"	20
"	"	25 Ap 1884	"	20
"	"	"	"	20
"	"	18 Mar 1885	"	20
"	"	2 Ap 1885	"	20
"	"	1 Mar 1886	"	20
"	"	10 Mar 1886	"	20
"	"	25 Ap 1886	"	20
"	"	5 My 1886	"	20
Saratoga	Day	3 O 1887	L. J. De Long	20
"	"	6 Ja 1890	A. P. Flansburgh	20
St Lawrence	Canton	15 F 1878	Hiram Hutchins	20
"	Colton	23 N 1880	"	20
"	"	15 Ja 1881	"	20
"	Fine	7 Je 1871	S. B. Ward	20
"	"	22 Je 1871	"	20
"	"	"	"	20
"	"	15 Je 1871	John Muir	20
"	"	26 Je 1871	"	20
"	"	29 Je 1871	"	20
"	"	23 O 1872	Henry Marsh	20
"	"	8 Je 1873	John Muir	20
"	"	24 Ja 1877	Webster Pastlow	20
"	"	1 My 1879	George Muir	20
"	"	15 Je 1880	"	20
"	"	26 Ap 1881	"	20
"	"	23 My 1881	"	20
"	"	16 Jl 1881	"	20
"	"	26 Ag 1881	"	20
"	"	10 S 1881	"	20
"	"	"	"	20
"	"	6 O 1881	"	20
"	"	7 O 1881	"	20
"	"	7 N 1881	"	20
"	Hopkinton	19 N 1873	N. A. Gale	20
"	"	4 N 1874	N. E. Wait	20
"	"	26 D 1876	C. N. Gale	20
"	"	12 O 1879	Peter Brosseau	20
"	Parishville	24 O 1875	Michael Duffy	20
"	Pitcairn	21 Je 1883	George Muir	20
"	"	22 Je 1883	"	20
"	"	22 Jl 1883	"	20
"	"	"	"	20
"	"	15 S 1883	"	20
"	"	23 D 1883	"	20
"	"	"	"	20
"	"	21 Mar 1884	"	20
"	"	1 D 1884	"	20
"	"	26 Ja 1885	"	20
"	"	27 Mar 1885	"	20
"	"	28 Mar 1885	"	20
"	"	15 My 1885	"	20
"	"	23 My 1885	"	20
"	"	25 Ap 1886	"	20
"	Township No. 11	24 O 1871	Michael Duffy	20

Summary by counties

County	Number killed	Amount paid
Essex	8	$160
Franklin	2	40
Hamilton	13	260
Herkimer	15	300
Lewis	23	460
Saratoga	2	40
St Lawrence	44	880
Total	107	$2 140

Summary by years

Year	Number killed	Amount paid
1871	8	$160
1872	6	120
1873	3	60
1874	1	20
1875	1	20
1876	2	40
1877	4	80
1878	6	120
1879	2	40
1880	3	60
1881	10	200
1882	14	280
1883	21	420
1884	9	180
1885	7	140
1886	5	100
1887	3	60
1888	1	20
1889	0	....
1890	1	20
1891	0	....
1892	0	....
1893	0	....
1894	0	....
1895	0	....
1896	0	....
1897	0	....
Total	107	$2 140

Lynx canadensis (Kerr) *Canada lynx*

1792 *F[elis] Lynx canadensis* Kerr, Animal kingdom 1 : 157.

1817 *Lynx canadensis* Rafinesque, Am. monthly magazine. 2 : 46.

1817 *Lynx montanus* Rafinesque, Am. monthly magazine. 2 : 46. (Catskill mts).

1842 *Lyncus borealis* De Kay, Zoology of New York, Mammalia. p. 50.
1882 *Lynx canadensis* Merriam, Linn. soc. New York. Trans. 1:40.
1898 *Lynx canadensis* Mearns, U. S. Nat. mus. Proc. 21:359.

Type locality. Canada.

Faunal position. Hudsonian and Canadian zones, formerly perhaps transition zone also.

Habitat. Forests.

Distribution in New York. The Canada lynx is rapidly approaching extinction in New York and in fact throughout the eastern part of its range. It still exists in the Adirondacks and probably in the Catskills also.

Principal records. De Kay: "It is not uncommon in the northern districts of the state" ('42, p. 51). Merriam: "The lynx is and so far as I can learn has always been a rather rare inhabitant of this region. It is most often met with on the Champlain or eastern side of the woods but is nowhere common, ('82, p. 40). Mearns: "Hunters told me that there are still a good many lynxes . . . in the [Catskill] mountains. Very large tracks of a lynx which I suppose to have been this species . . were seen almost daily on the summit of Hunter mountain during the latter part of August. . . . During the winter of 1877–78 a Canada lynx was killed near Rhinebeck on the Hudson and brought to Prof. James M. De Garmo, in whose collection I saw it soon after. This is the only record of its occurrence in the immediate vicinity of the Hudson river, during recent years that has been brought to my attention" ('98, p. 359).

Lynx ruffus (Gueldenstaedt) *Wildcat*

1776 *Felis ruffa* Gueldenstaedt, Novi comment. acad. scient. Imp. Petropolitanae. (1775), 20:484. 1776.
1842 *Lyncus rufus* De Kay, Zoology of New York, Mammalia. p. 51.
1882 *Lynx rufus* Merriam, Linn. soc. New York. Trans. 1:41.
1896 *Lynx rufus* Fisher, The Observer. May 1896. 7:198.
1897 *Lynx ruffus* Rhoads, Acad. nat. sci. Philadelphia. Proc. p. 32.
1898 *Lynx ruffus* Mearns, Am. mus. nat. hist. Bul. 9 Sep. 1898. 10:351.
1898 *Lynx ruffus* Mearns, U. S. Nat. mus. Proc. 21:359.

Type locality. New York.

Faunal position. Canadian, transition and upper austral zones.

Habitat. Forests.

Distribution in New York. The wildcat, which once ranged throughout the state, appears to be now exterminated except in the wilder parts of the Adirondacks, the Catskills and the Hudson highlands. It is, however, an animal that resists the progress of forest clearing much more

successfully than the Canada lynx, and consequently may be looked for in many localities where the latter is no longer found.

Principal records. De Kay: "They are still found in the more northern and western counties in the wooded districts" ('42, p. 53). Merriam: "The wildcat is for some reason an extremely rare animal in the Adirondacks" ('82, p. 41) Fisher: "It is probable that a few wildcats still remain in the wilder parts of the region. The last one killed in the neighborhood [of Sing Sing] as far as we know, was shot by a Mr Reynolds at Katonah [Westchester co.] in March, 1880" ('96, p. 198–99). Mearns: "On my last visit to the [Hudson] highlands in 1896 I saw no signs of the wildcat, and I was told that none had been killed there for several years past. During the first 25 years of my life the wildcat was at least as numerous as the red fox and more frequently killed. In the early seventies wildcats by their depredations caused so much loss to the residents of Putnam co., across the Hudson from my home, that bounties were privately subscribed by landowners amounting to $25 for every one killed in that neighborhood. Mr Henry Le Farge still a hunter of local renown killed a considerable number of them, but there were still some wildcats remaining on Sugar Loaf mountain when I left the Highlands in 1884 ('98a, p. 351). Several stuffed specimens of wildcats said to have been killed in that neighborhood are preserved in the hotels and stores of the Catskills. It is in fact fairly common in these mountains" ('98b, p. 359).

Urocyon cinereoargenteus (Schreber) *Gray fox*

1775 *Canis cinereoargenteus* Schreber, Säugethiere. pl. 92.

1785 *Canis vulpes Δ pennsylvanicus* Boddaert, Elenchus Animalium. 1:97. Based on the Brant Fox of Pennant.

1842 *Vulpes virginianus* De Kay, Zoology of New York, Mammalia. p. 45.

1894 *Urocyon cinereoargenteus* Rhoads, American naturalist. June 1894. 28:524.

1896 *Urocyon virginianus* Fisher, The Observer. May 1896. 7:199.

1898 *Urocyon cinereoargenteus* Mearns, Am. mus. nat. hist. Bul. 9 Sep. 1898. 10:350.

1898 *Urocyon cinereoargenteus* Mearns, U. S. Nat. mus. Proc. 21:360.

Type locality. North America.

Faunal position. The gray fox is a strictly austral animal.

Habitat. Woods, thickets, rocky hillsides and in fact all dry situations.

Distribution in New York. The gray fox enters New York with the upper austral fauna at the extreme west, in the Hudson valley and on Long Island.

Principal records. De Kay: "This species is more common in the southern counties than farther north. On Long Island it is very abundant" ('42, p. 46). Fisher: "Not uncommon [at Sing Sing] but much rarer than the red fox. Judging from the number killed the red fox is five times more common than the gray" ('96, p. 199). Mearns: "This is the common fox of the [Hudson highlands] region, the red fox being comparatively scarce. It is very destructive to poultry" ('98a, p. 350). "A few gray foxes were said to have made their appearance in the upper part of Schoharie valley during recent years" ('98b, p. 360).

I have never met with the gray fox in New York.

Mr Savage writes me that he has reliable evidence of the recent capture of several gray foxes near Buffalo.

Mr Helme writes: "The gray fox was formerly quite common on Long Island, but now it is nearly extinct. I have heard of no specimens taken during the past four or five years."

Vulpes fulvus Desmarest *Red fox*

1820 *Canis fulvus* Desmarest, Mammalogie. p. 203

1842 *Vulpes fulvus* De Kay, Zoology of New York, Mammalia. p. 44.

1882 *Vulpes vulgaris pennsylvanicus* Merriam, Linn. soc. New York. Trans. 1 : 45. (Not of Boddaert)

1896 *Vulpes pennsylvanicus* Fisher, The Observer. May 1896. 7 : 109.

1898 *Vulpes pennsylvanicus* Mearns, U. S. Nat. mus. Proc. 21 : 358.

1898 *Vulpes pennsylvanicus* Mearns, Am. mus nat. hist. Bul. 9 Sep. 1898. 10 : 350.

Type locality. Virginia.

Faunal position. Upper austral, transition and Canadian zones.

Habitat. While its habitat is primarily forests the red fox can accômmodate itself to an almost endless variety of conditions.

Distribution in New York. The red fox occurs throughout the state.

Principal records. De Kay: (No details given but the inference is that the author considered the animal well known everywhere in New York). Merriam: "The common fox is a tolerably abundant resident in the north woods" ('82, p. 45). Fisher: Common [in the neighborhood of Sing Sing] ('96, p. 199). Mearns: "This splendid animal is not numerous in the [Hudson] highlands. It prefers more open country" ('98a, p. 350). "This fox is known to be tolerably common throughout the Schoharie valley" ('98 b, p. 358).

I have found the red fox not uncommon at Geneva, Ontario co.; Peter boro, Madison co. and Elizabethtown, Essex co.

Mr Savage reports it not uncommon in Erie co.

"The red fox is plentiful in most sections of Long Island east of the township of Oyster bay" (Helme).

Canis occidentalis (Richardson) *Timber wolf*

1829 *Canis lupus occidentalis* Richardson, Fauna Boreali-Americana. 1:60.

1842 *Canis lupus* De Kay, Zoology of New York, Mammalia. p. 42.

1882 *Canis lupus* Merriam, Linn. soc. New York. Trans. 1:42.

1898 *Canis nubilis* Mearns, U. S. Nat. mus. Proc. 21:360.

1898 *Canis occidentalis* Bangs, American naturalist. July 1898. 32:505.

Type locality. Northern North America.

Faunal position. This animal is so imperfectly known that it is impossible to assign it a definite faunal position.

Habitat. Forests.

Distribution in New York. While the wolf formerly ranged throughout the state it is now exterminated everywhere except in the wildest parts of the Adirondacks.

Principal records. De Kay: "In some of the southern counties, where they were formerly so numerous as to require legislative enactments, they are now nearly extirpated . . . They are still found in the mountainous and wooded parts of the state and we believe are most numerous in St Lawrence and the adjacent counties" ('42, p. 43).

Merriam: "Comparatively few wolves are now to be found in the Adirondacks, though 12 years ago they were quite abundant and used to hunt in packs of half a dozen or more . . . In September 1870 I saw a pack of wolves drive a deer into the head of Seventh lake, Fulton chain . . . In the year 1871 the state put a bounty on their scalps, and it is a most singular coincidence that a great and sudden decrease in their number took place at about that time. What became of them is a great and to me inexplicable mystery, for it is known that but few were killed" ('82, p. 42-43).

Mearns: "It is generally believed that the last wolf disappeared from the Catskills along with the deer many years ago though one man expressed the belief that some still remain" ('98, p. 360).

In 1823 Pierce found the wolf still common in the Catskills. He believed that there were "two varieties, . . . one called the deer wolf from his habit of pursuing deer for which his light grey hound form adapts him. The other of a more clumsy figure with short legs and large body more frequently depredates upon flocks under the protection of man" ('23, p. 93).

It is needless to say that there is very little probability that two forms of wolf have occurred in New York in historic times. Nevertheless Pierce's statement has its interest, for the prominence given it by Darwin in his *Origin of species* (p. 71) if for nothing else.

Remarks. The data which form the basis of the accompanying table of wolf bounties were furnished by Dr Frederick J. H. Merrill.

Table of bounties paid for wolves in New York under law of 1871

County	Town	Date	By whom killed	Amount paid
Broome	Barker	23 F 1881	B. H. Moak	$30
Essex	Minerva	6 S 1872	Wesley Rice	30
"	"	"	"	30
"	"	25 Jl 1885	Samuel Wilson	30
Franklin	Brandon	12 Je 1875	Calvin Wait	30
"	"	17 Je 1875	"	30
"	Duane	4 Jl 1874	J. H. Bean	30
Fulton	Bleecker	10 Ap 1895	E. Kosobuske	30
Hamilton	Long Lake	28 Mar 1882	Peter Fahlgren	30
"	"	1 Ap 1882	"	30
"	"	27 S 1882	George Muir	30
"	"	25 Mar 1883	"	30
"	"	17 Ja 1887	J. H. Higbey	30
"	Wells	16 Mar 1883	Peter Decker	30
"	"	"	"	30
Herkimer	Ohio	28 Ja 1882	Henry Sheldon	30
"	"	"	"	30
"	Wilmurt	8 Jl 1883	George Muir	30
Lewis	Batchfordville	10 N 1881	Frank Riley	30
"	Diana	27 Je 1882	George Muir	30
"	"	27 Ap 1884	"	30
"	"	10 My 1895	"	30
"	"	18 My 1895	"	30
"	"	18 Ap 1896	"	30
"	"	16 S 1896	"	30
"	"	22 O 1896	"	30
"	"	20 D 1896	"	30
"	"	7 Ja 1897	"	30
"	"	31 My 1897	"	30
"	"	5 Ag 1897	"	30
"	"	23 S 1897	"	30
"	Greig	10 N 1881	George Botchford	30
"	Lyonsdale	4 O 1882	John Camp	30
"	"	13 O 1882	"	30
"	"	17 N 1882	"	30
"	"	15 D 1882	Thomas Lee	30
Oneida	Floyd	8 F 1886	W. A. & I. E. Bennett.	30
"	Forestport	14 F 1882	Henry Durrin	30
"	"	15 Mar 1882	"	30
"	"	19 Mar 1882	"	30
"	"	2 Ap 1882	Daniel Rodgers	30
"	"	9 Ap 1882	"	30
"	"	14 O 1882	Henry Durrin & S. L. Fones	30
"	"	19 O 1882	Henry Durrin & S. L. Fones	30
"	"	18 D 1882	Henry Durrin	30
Otsego	Plainfield	14 F 1888	J. D. Wilkinson	30

Table of bounties paid for wolves in New York under law of 1871, continued

County	Town	Date	By whom killed	Amount paid
St Lawrence	Brasher	21 D 1872	Timothy Desmond	$30
"	Clifton	8 Je 1895	George Muir	30
"	"	10 S 1895	"	30
"	"	18 S 1895	"	30
"	"	1 S 1896	"	30
"	"	30 O 1896	"	30
"	"	15 O 1897	"	30
"	"	30 N 1897	"	30
"	Colton	5 N 1880	Abram Barkley	30
"	Fine	17 O 1871	John Muir	30
"	"	26 My 1872	"	30
"	"	7 N 1872	"	30
"	"	22 My 1875	"	30
"	"	24 My 1875	"	30
"	"	15 My 1876	"	30
"	"	5 My 1877	"	30
"	"	14 Jl 1877	"	30
"	"	8 Ap 1878	George Muir	30
"	"	16 S 1878	"	30
"	"	29 Ap 1879	"	30
"	"	26 Ap 1880	"	30
"	"	3 O 1880	"	30
"	"	28 Ap 1881	"	30
"	"	23 My 1881	"	30
"	"	11 Je 1881	"	15
"	"	"	"	30
"	"	20 Jl 1881	"	30
"	"	24 Ag 1881	"	30
"	"	28 S 1881	"	30
"	"	8 N 1881	"	30
"	Fowler	7 Je 1888	W. S. Clark	30
"	Hopkinton	17 Ag 1871	George Speare	30
"	"	"	"	15
"	"	6 O 1871	Joseph Whitney	30
"	"	9 O 1876	George Peck	30
"	"	6 N 1880	Jonathan Baldwin	30
"	"	13 N 1880	H. C. Hibbard	30
"	"	20 S 1881	"	30
"	Parishville	13 N 1880	"	30
"	Pitcairn	4 N 1872	Aaron Thomas	30
"	"	12 D 1873	"	30
"	"	1 N 1884	Geore Muir	30
"	"	26 Je 1885	"	30
"	"	4 Jl 1885	"	30
"	"	10 Ap 1886	"	30
Warren	Thurman	10 F 1883	Roland Gamby	30
"	"	14 F 1883	"	30
Washington	Dresden	10 Mar 1882	"	30
"	"	"	"	30
"	"	3 Ag 1882	"	30
"	"	3 Mar 1883	"	30
"	Kingsbury	17 Ja 1883	William Casey	30
"	"	24 F 1883	Samuel Ferris	30

Summary by counties

County	Number killed	Amount paid
Broome	1	$30
Essex	3	90
Franklin	3	90
Fulton	1	30
Hamilton	7	210
Herkimer	3	90
Lewis	18	540
Oneida	9	270
Otsego	1	30
St Lawrence	45	1 335
Warren	1	30
Washington	6	180
Total	98	$2 910

Summary by years

Year	Number killed	Amount paid
1871	4	$105
1872	6	180
1873	1	30
1874	1	30
2875	4	120
1876	2	60
1877	2	60
1878	2	60
1879	1	30
1880	6	180
1881	12	345
1882	21	630
1883	9	270
1884	2	60
1885	2	60
1886	2	60
1887	1	30
1888	2	60
1889	0	....
1890	0	....
1891	0	....
1892	0	....
1893	0	....
1894	0	....
1895	6	180
1896	6	180
1897	6	180
Total	98	$2 910

Ursus americanus Pallas *Black bear*

1780 *Ursus americanus* Pallas, Spicilegia zoologica. Fasc. 14 : 5.
1842 *Ursus americanus* De Kay, Zoology of New York, Mammalia. p. 42.
1882 *Ursus americanus* Merriam, Linn. soc. New York. Trans. 1 : 95.
1898 *Ursus americanus* Mearns, U. S. Nat. mus. Proc. 21 : 357.

Type locality. North Carolina.

Faunal position. The geographic variations of the black bear are so imperfectly known that it is impossible to tell at present over what zones the form found in New York extends.

Habitat. Forests.

Distribution in New York. The black bear is now exterminated throughout the state except in the region of the Adirondacks and Catskills.

Principal records. De Kay: "The bear, once so numerous in this state, is now chiefly to be found in the mountainous and thinly inhabited districts"—('42, p. 24). Merriam: "This . . . mammal . . . is still abundant in most parts of the wilderness" ('82, p. 95). Mearns: "Though still common in the Adirondack and Catskill mountains the bear disappeared from the [Hudson] highlands many years ago though my father's mother saw them there ('98a, p. 352). I saw recent signs of bears on Plateau mountain, in August, 1896. Several bears were killed a few miles south of the mountain during the same month . . . This species is far from being exterminated in the Catskills" ('98b, p. 357).

Lutra canadensis canadensis (Schreber) *Northeastern otter*

1776 *Mustela lutra canadensis* Schreber, Säugethiere. 3 : pl. 126 B.
1803 *Mustela hudsonica* Desmarest, Nouv. dict. d'hist. nat. 13 : 384.
1831 *Lutra hudsonica* F. Cuvier, Suppl. Oeuvres de Buffon. 1 : 194.
1842 *Lutra canadensis* De Kay, Zoology of New York, Mammalia. p. 39.
1882 *Lutra canadensis* Merriam, Linn. soc. New York. Trans. 1 : 87.
1896 *Lutra canadensis* Fisher, The Observer. May 1896. 7 : 199.
1898 *Lutra hudsonica* Mearns, Am. mus. nat. hist. Bul. 9 Sep. 1898. 10 : 347.
1898 *Lutra hudsonica* Mearns, U. S. Nat. mus. Proc. 21 : 360.

Type locality. Eastern Canada.

Faunal position. Boreal and transition zones.

Habitat. Borders of lakes, rivers, streams and marshes.

Distribution in New York. While the otter has doubtless greatly decreased in numbers during the present century it probably still occurs throughout the greater part of New York. Details of its present distribution are however wholly lacking.

Principal records. De Kay: "The American otter, once so numerous in every part of the state, is now exceedingly scarce. In the counties of Kings, Queens, Suffolk and Richmond it is now extirpated. In the northern districts it is yet sufficiently numerous to become an object of pursuit" ('42, p. 40). Merriam: "The otter is a common inhabitant of the Adirondacks" ('82, p. 87). Fisher: "Probably it still rarely occurs at Croton lake and river. The last specimen we have any record of was taken in the tide creeks in Croton point about 1880" ('96, p. 199). Mearns: "Otters are still found in the Hudson and in the streams and lakes of the Highlands though the species has now become extremely scarce. 20 years ago it was more numerous" ('98a, p. 347). "Otters were said by one or two of the Catskill residents to have been taken occasionally along Schoharie creek and at Kaaterskill lake during the past 25 years" ('98b, p. 360).

Mr Helme writes that the otter is nearly if not quite extinct on Long Island.

Remarks. It is possible that the otter of the Hudson highlands and Long Island is the southeastern otter *Lutra hudsonica lataxina* (F. Cuvier) recently distinguished from the northern form by Rhoads ('98c, p. 420).

Mephitis mephitica (Shaw) *Skunk*

1792 *Viverra mephitica* Shaw, Museum Leverianum. p. 172.

1842 *Mephitis americana* De Kay, Zoology of New York, Mammalia. p. 29.

1858 *Mephitis mephitica* Baird, Mamm. N. Am. p. 195.

1882 *Mephitis mephitica* Merriam, Linn. soc. New York. Trans. 1 : 69.

1896 *Mephitis mephitica* Fisher, The Observer. May 1896. 7 : 199.

1898 *Mephitis mephitica* Mearns, U. S. Nat. mus. Proc. 21 : 358.

1898 *Mephitis mephitica* Mearns, Am. mus. nat. hist. Bul. 9 Sep. 1898. 10 : 350.

Type locality. North America.

Faunal position. Until the exact status of the skunks found in New York is better understood it will be impossible accurately to state their faunal position.

Habitat. Woods, fields and in fact anywhere, provided the ground is dry enough for burrowing.

Distribution in New York. The skunk occurs throughout the state. This is probably an animal whose range has been slightly if at all affected by the removal of the forests, but which has undoubtedly increased in numbers with the transformation of forests into farms.

Principal records. De Kay: "This well known and thoroughly detested animal is supposed to exist throughout the whole American continent" ('42, p. 30). Merriam: "The skunk is very common in the clearings and settled districts bordering this region and is found sparingly throughout the Adirondacks" ('82, p. 69). Fisher: "Common [at Sing Sing]. A very beneficial animal and one that should be carefully protected" ('96, p. 199). Mearns: "Common. Three specimens were trapped on the banks of Schoharie creek. It was not met with on the mountains" ('98b, p. 358).

I have found the skunk common at Geneva, Ontario co. and at Peterboro, Madison co.

Of the presence of the animal in the neighborhood of Buffalo Mr Savage writes: "The skunk is common, occasionally coming into the heart of the city. About three winters ago I came upon five dead skunks in 10 days all within a radius of three-quarters of a mile and all within the city limits. Last fall a friend dug out a rabbit that his dog had 'holed,' and found that in the short time occupied by the work of excavation the animal had been killed and partly eaten by a skunk that happened to be occupying the hole." Mr Helme says: "The skunk is common but for some unknown reason it is much less numerous than formerly."

Remarks. It is probable that the skunk of the upper austral areas in New York is subspecifically distinct from that occurring in the Canadian zone, but at present there is no material with which to decide the question. If there are two forms the Canadian animal is *Mephitis mephitica mephitica*, the upper austral, *M. mephitica scrutator* Bangs. The ranges of these subspecies are given by Bangs as follows: *M. mephitica mephitica*, "Boreal eastern North America; Nova Scotia, Quebec, and Ontario south to about the northern limits of the United States" ('96d, p. 140); *M. mephitica scrutator*, "Pine and prairie regions of central Louisiana, extending up the Mississippi valley to Indiana and eastward across the Alleghanies to Virginia and thence northward, gradually becoming less typical until it merges into true *mephitica*" ('96d, p. 141).

It is of interest to note that De Kay in speaking of this animal now so extensively trapped for its fur says: "His fur is coarse and of no value as an article of commerce" ('42, p 30).

Gulo luscus (Linnaeus) *Wolverine*

1758 *Ursus luscus* Linnaeus, Syst. nat. ed. 10. 1 : 47.
1823 *Gulo luscus* J. Sabine, Franklin jour. p. 650.
1842 *Gulo luscus* De Kay, Zoology of New York, Mammalia. p. 27.
1882 *Gulo luscus* Merriam, Linn. soc. New York. Trans. 1 : 47.

Type locality. Hudson bay.

Faunal position. Boreal and transition zones.

Habitat. Forests.

Distribution in New York. While the wolverine has within historic times ranged throughout the state it is now wholly exterminated.

Principal records. De Kay: "Although we have not met with this animal yet hunters who have killed them repeatedly and knew them well have assured us that they are still found in the districts north of Raquet lake. It is however everywhere a rare species" ('42, p. 28). Merriam: "The wolverine (*Gulo luscus*) is not now an inhabitant of the Adirondacks, and I have been unable to find among the hunters and trappers of this region anyone who has ever seen it in our wilderness" ('82, p. 47–48). Bachman states (Audubon and Bachman, '46, 1 : 207–8) that about the year 1811 he killed a wolverine in Rensselaer co.

Putorius vison vison (Schreber) *Northeastern mink*

1778 *Mustela vison* Schreber Säugethiere. 3 : 463.
1830 *Putorius vison* Gapper Zool. jour. 5 : 202.
1853 *Putorius nigrescens* Audubon and Bachman Quadr. N. Am. 3 : 104.
1882 *Putorius vison* Merriam Linn. soc. New York. Trans. 1 : 64.
1896 *Putorius vison* Bangs Boston soc. nat. hist. Proc. 27 : 3.
1898 *Putorius vison* Mearns U. S. Nat. mus. Proc. 21 : 358.

Type locality. Canada.

Faunal position. Hudsonian and Canadian zones.

Habitat. Borders of lakes, ponds and water courses.

Distribution in New York. The northeastern mink is not found in New York outside of the Adirondacks and Catskills.

Principal records. Merriam: "The mink is a well-known and tolerably abundant inhabitant of this region ('82, p. 64). Mearns: "This small mink is common on all the streams of the neighborhood [Catskill mts] and at Kaaterskill lake" ('98b, p. 358).

Putorius vison lutreocephalus (Harlan). *Southeastern mink*

1825 *Mustela lutreocephala* Harlan, Fauna Americana. p. 63.
1842 *Putorius vison* De Kay, Zoology of New York, Mammalia. p 37.

1896 *Putorius vison lutreocephalus* Bangs, Boston soc. nat. his. Proc. March 1896. 27:4.

1896 *Lutreola vison* Fisher, The Observer. May 1896. 7:199.

1898 *Putorius* (*Lutreola*) *vison lutreocephalus* Mearns, Am. mus. nat. hist. Bul. 9 Sep. 1898. 10:347.

Type locality. Maryland.

Faunal position. Transition zone and upper austral zone.

Habitat. Borders of lakes, ponds and water courses.

Distribution in New York The southeastern mink occurs throughout the central and southern part of the state except in the Catskills where it is replaced by the northeastern form. The limits of distribution of both subspecies are however understood in a general way only.

Principal records. De Kay: "The mink is a well-known animal in every part of the state. Its popular name is corrupted from *mænk* given to it by our early Swedish colonists" ('42, p. 38). Fisher: "Common along all the larger streams and ponds [in the vicinity of Sing Sing]" ('96, p. 199). Mearns: "Minks have 'always' been rather common in this vicinity [the Hudson highlands]" ('98a, p. 347).

Mink are tolerably common at Peterboro, Madison co., but I am unable to determine the exact status of the form that occurs there. It is probably not exactly typical of either subspecies.

Mr Savage writes that: "The mink is very common in swamps and along streams in Erie co. I am inclined to think that the form found here is intermediate between typical *vison* and the subspecies *lutreocephalus*. Recently I examined two mink in the flesh which measured respectively 559 mm and 582 mm in total length."

According to Mr Helme the southeastern mink is not uncommon on Long Island.

Remarks. The forms of mink that occur in New York are much in need of critical revision but material for such study is lacking. In Bangs's paper on the mink ('96a) *Putorius vison lutreocephalus* is referred to as an Atlantic coast form. Its range into the interior doubtless includes the whole of the area in New York occupied by the transition and upper austral zones, but proof of the correctness of this supposition is much to be desired.

Putorius cicognanii (Bonaparte) *Bonaparte's weasel*

1838 *Mustela cicognanii* Bonaparte, Charlesworth's magazine. Jan. 1838. 2:37.

1839 *Putorius cicognanii* Richardson, Zool. Beechey's Voyage of the Blossom. p. 10.

1842 *Mustela pusilla* De Kay, Zoology of New York, Mammalia. p. 34.
1842 *Mustela fusca* De Kay, Zoology of New York, Mammalia. p. 35.
1882 *Putorius vulgaris* Merriam, Linn. soc. New York. Trans. 1: 54.
1896 *Putorius richardsoni cicognanii* Bangs, Biolog. soc. Washington, Proc. 25 Feb. 1896. 10: 18.
1896 *Putorius cicognanii* Merriam, North American fauna. no. 11. 30 June 1896. p. 10.
1898 *Putorius cicognanii* Mearns, Am mus. nat. hist. Bul. 9 Sep. 1898. 10: 349.
1898 *Putorius cicognanii* Mearns, U. S. Nat. mus. Proc. 21: 358.

Type locality. Eastern United States.

Faunal position. Hudsonian, Canadian and transition zones.

Habitat. Woods and thickets.

Distribution in New York. Bonaparte's weasel occurs through the entire state, with the possible exception of the upper austral areas. These however are so narrow that they might readily be penetrated by a roving animal like a weasel. Bangs ('96a, p. 19) records it from Long Island.

Principal records. De Kay: "It is by no means a rare animal but is difficult to capture" ('42, p. 35). Merriam: "It is the commonest weasel in the Adirondack region" ('82, p. 54). Mearns: "About the year 1870 I trapped one or two of these little short tailed weasels on our place at Highland falls and I have seen a few of them since. It is probably quite uncommon" ('98a, p. 349). "One specimen, a male . . . was trapped on the left bank of Schoharie creek, August 23, 1896" ('98b, p. 358).

This weasel is tolerably common at Peterboro, Madison co.

Of the occurrence of Bonaparte's weasel in Erie co. Mr Savage writes: "Have seen a single *P. cicognani.*"

Remarks. The confusion of names applied to this animal for many years arose partly from the sexual variation to which the species is subject and partly from lack of a clear conception of the differences which separate it from the common stoat of Europe. The whole subject is thoroughly explained by Bangs ('96a, p. 20–21) and Merriam ('96, p. 10).

Putorius noveboracensis Emmons *New York weasel.*

1840 *Putorius noveboracensis* Emmons, Rep. Quad. Massachusetts. p. 45.
1842 *Putorius noveboracensis* De Kay, Zoology of New York. Mammalia. p. 36.

1854 *Putorius agilis* Audubon and Bachman, Quad. N. Am. 3 : 184.
1882 *Putorius erminea* Merriam, Linn. soc. New York. Trans. 1 : 56.
1896 *Putorius noveboracensis* Bangs, Biolog. soc. Washington, Proc. 25 Feb. 1896. 10: 13.
1896. *Putorius noveboracensis* Fisher, The Observer. May 1896. 7 : 199.
1898 *Putorius noveboracensis* Mearns, Am. mus. nat. hist. Bul. 9 Sep. 1888. 10 : 348.
1898 *Putorius noveboracensis* Mearns, U. S. Nat. mus. Proc. 21 : 358.

Type locality. New York state.

Faunal position. Upper austral and transition zones and lowermost edge of Canadian zone.

Habitat. Woods and thickets.

Distribution in New York. Owing to the confusion that has long existed in regard to the identification of our weasels it is now difficult to tell the exact limits of the range of this species. The animal is probably to be found in all parts of the state with the exception of the depth of the boreal areas.

Principal records. De Kay: "Its geographic limits as yet are not settled. We suppose it to be a northern animal found as far south as Pennsylvania" ('42, p. 37). Merriam: "The ermine is a common resident" ('82, p. 56). Fisher: "Tolerably common" ('96, p. 199). Mearns: "One was seen at Evelyne Villa in August 1896" ('98b, p. 358).

I have never met with this weasel in New York.

Mr Savage writes: "The New York weasel is common in Erie co."

Of the New York weasel on Long Island Mr Helme writes: "This animal is common. Although I have met with it several times in winter I have never seen a specimen in white pelage."

Mustela americana Turton *Marten*

1806 *Mustela americana* Turton, General system of nature. 1 : 60.
1842 *Mustela martes* De Kay, Zoology of New York, Mammalia. p. 32.
1882 *Mustela americana* Merriam, Linn. soc. New York. Trans. 1 : 52.
1898 *Mustela americana* Mearns, U. S. Nat. mus. Proc. 21 : 360.

Type locality. North America.

Faunal position. Boreal zones, and perhaps transition zone also, though in eastern North America the animal is exterminated in the latter.

Habitat. Forests.

Distribution in New York. The marten is now confined to the wilder parts of the Adirondacks.

Principal records. De Kay: "Its geographic range extends from the Atlantic to the Pacific" ('42, p. 34). Merriam: "The marten is a common resident of the dark evergreen forests of the Adirondacks, and hundreds of them are trapped here every winter for their fur" ('82, p. 52). Mearns: "Some of the residents assert that both the pine marten and the pekan, *M. pennanti* Erxleben, are still sometimes taken in the Catskills, others exclude the pekan, but say that the marten still exists" ('98b, p. 360).

Mustela pennanti Erxleben *Fisher*

1777 *Mustela pennanti* Erxleben, Syst. regn. anim. p. 470.
1842 *Mustela canadensis* De Kay, Zoology of New York, Mammalia. p. 31.
1882 *Mustela pennanti* Merriam, Linn. soc. New York. Trans. 1 : 48.
1898 *Mustela pennanti* Mearns, U. S. Nat. mus. Proc. 21 : 360.

Type locality. Canada.

Faunal position. Boreal zone and probably transition zone also.

Habitat. Forests.

Distribution in New York. The fisher which formerly ranged through the greater part of the state is now confined to the wilder parts of the Adirondacks though it occasionally wanders outside of this region.

Principal records. De Kay: "The fisher or black cat of our hunters, is a large and powerful animal, standing nearly a foot from the ground. It was formerly very abundant in this state, but is now confined to the thinly settled northern district. Twenty years ago they were numerous in the western part of the state, where they are now scarcely ever seen" ('42, p. 31–32). Merriam: "Though not so common as formerly, the fisher . . . is by no means a rare inhabitant of these [Adirondack] mountains" ('82, p. 48). Mearns: (see under *Mustela americana*).

Of the occurrence of this animal in Erie co. Mr Savage writes: "The fisher was probably common in this region before it was trapped out and the forests destroyed. In March, 1889, a fisher was killed after being found under a lumber pile near the Niagara river and in the city of Buffalo. It was mounted by Miss Mathilde Schlegel now of East Aurora, New York."

Procyon lotor Linnaeus *Raccoon*

1758 [*Ursus*] *lotor* Linnaeus, Syst. nat. ed. 10. 1 : 48.
1780 *Procyon lotor* Storr, 'Prodr. Meth. Mamm.'
1842 *Procyon lotor* De Kay, Zoology of New York, Mammalia. p. 26.

1882 *Procyon lotor* Merriam, Linn. soc. New York. Trans. 1 : 91.
1896 *Procyon lotor* Fisher, The Observer. May 1896. 7 : 200.
1898 *Procyon lotor* Mearns, U. S. Nat. mus. Proc. 21 : 357.

Type locality. Northeastern United States.

Faunal position. Austral zones, transition zone and southern border of Canadian zone.

Habitat. Forests.

Distribution in New York. The raccoon occurs throughout the state. It is probably one of the mammals whose range has been very little changed by the clearing of the country.

Principal records. De Kay: "The raccoon is found all over North America". ('42, p. 27). Merriam: "Raccoons are common everywhere about the borders of the Adirondacks, but they do not like dense evergreen forests and are therefore rather rare in the interior, still they are occasionally met in all parts of the wilderness" ('82, p. 91). Fisher: "Common [near Sing Sing]. Found everywhere but more commonly in the swamps and along streams" ('96, p. 200). Mearns: "Tracks of the raccoon were seen in several places on or near Schoharie creek" ('98, p. 357).

I have found the raccoon common at Peterboro, Madison co.

Mr Savage writes: "The raccoon is common in Erie co."

Of this animal Mr Helme writes: "The raccoon is still quite common in most of the less thickly settled districts of Long Island."

Phoca vitulina Linnaeus *Harbor seal*

1758 [*Phoca*] *vitulina* Linnaeus, Syst. nat. Ed. 10. 1 : 38.
1842 *Phoca concolor* De Kay, Zoology of New York, Mammalia. p. 53.
1882 *Phoca vitulina* Merriam, Linn soc. New York. Trans. 1 : 104.
1896 *Phoca vitulina* Fisher, The Observer. May 1896. 7 : 200
1898 *Phoca vitulina* Mearns, Am. mus. nat. his. Bul. 9 Sep. 1898. 10 : 346.

Type locality. Coast of Europe.

Distribution in New York. The harbor seal occurs regularly in Long Island sound and in the lower Hudson river. It also reaches the northern border of the state by way of the St Lawrence river, and on one occasion an individual penetrated as far into the interior as Onondaga lake.

Principal records. De Kay: "They are now comparatively rare in our waters, but were formerly very abundant . . . At some seasons even at the present day they are very numerous, particularly about the Execution

rocks in the sound, but their visits appear to be very capricious" ('42, p. 54).

Merriam: "The harbor seal breeds regularly both in the Gulf and River of St Lawrence and I have seen numbers of them in July as far up the river as the Saguenay, and they are still common even within 50 miles of Quebec."

"Zadock Thompson has recorded the capture of two of them on Lake Champlain ['42, p. 38].

"During a recent visit to Lake Champlain I was told that a seal had been killed on the ice near Crown point within four or five years but was unable to authenticate the statement.

"Dr De Kay mentioned the occasional occurrence of this species on Lake Ontario, many years ago, and during the past winter one was killed on Onondaga lake that must have reached this remote inland water by way of Lake Ontario. [Syracuse *Standard*, '82].

"I have seen many of these seals in Long Island sound chiefly about the Thimble islands, and March 25, 1879, I saw one on a rock in the Hudson river near Sing Sing" ('82, pp. 104–5).

Fisher: "Almost every spring one or more seals are seen [near Sing Sing] about the time the ice is breaking up in the river. On March 11, 1884, an adult male was secured in the cove" ('96, p. 200).

Mearns: "The seal has been seen several times and once captured in the Hudson highlands. One was shot at New Hamburg on the Hudson by a Mr Wood for whom the specimen was mounted by Mr James S. Buchanan, a taxidermist of Newburgh who showed me the specimen and four large jars of oil which he took from it. It was shot on the ice near an airhole in the river in midwinter 1877–78 and weighed 60 pounds" ('98a, p. 346).

For other records of the harbor seal in or near New York waters see Fisher '84, Merriam '84a and '84c and Syracuse *Standard* '82.

Mr Helme writes, "A few harbor seals are met with each winter along the rocky shores of the eastern part of Long Island. Occasionally they are found in the sound."

Cystophora cristata (Erxleben) *Hooded seal*

1777 *Phoca cristata* Erxleben, Syst. regn. anim. p. 590.

1841 *Cystophora cristata* Peters, Wiegmann's Archiv für Naturgeschichte, 7ter Jahrg. Bd. 1 : 326.

1842 *Stemmatopus cristatus* De Kay, Zoology of New York, Mammalia. p. 55.

Type locality. Southern Greenland.

Faunal position. Arctic zone.

Habitat. Ice floes and sea coasts.

Distribution in New York. The hooded seal has been taken in New York on one occasion only. It is a mere straggler to the coast of the United States, though it has been known to wander as far south as Chesapeake bay (Allen, '80, p. 737).

Principal records. De Kay: "This description was taken from an adult male captured near Eastchester about 15 miles from the city" ('42, p. 56).

Remarks. For an account of the 'hood' of this animal see Merriam, '84b.

Sorex albibarbis (Cope) *Water shrew*

1862 *Neosorex albibarbis* Cope, Acad. nat. sci. Philadelphia. Proc. p. 188.

1892 *Sorex albibarbis* Merriam, Biolog. soc. Washington. Proc. 7 : 25.

1894 *Sorex albibarbis* Miller, Boston sci. nat. hist. Proc. 26 : 183.

1895 *Sorex albibarbis* Miller, North American fauna, no. 10. p. 46.

Type locality. Profile lake, New Hampshire.

Faunal position. Boreal zone.

Habitat. Marshes, wet woods and the margins of streams and ponds.

Distribution in New York. The water shrew has been only once recorded from New York (Miller, '94, p. 47). Although it has not yet been found outside of Essex co. the animal doubtless ranges throughout the Adirondacks. It will probably be found in the Catskills as well as in other localities where the fauna is largely composed of boreal forms. Rhoads has taken the water shrew in Pike co. Pa. ('95a, p. 395).

Sorex fumeus Miller *Smoky shrew*

1884 *Sorex platyrhinus* Merriam, Linn. soc. New York. Trans. 2 : 77 (not *Otisorex platyrhinus* De Kay).

1895 *Sorex fumeus* Miller, North American fauna. no. 10. 31 Dec. 1895. p. 50.

1898 *Sorex fumeus* Mearns, U. S. Nat. mus. Proc. 21 : 354.

Type locality. Peterboro, Madison co. New York.

Faunal position. Boreal zone and cooler parts of transition zone.

Habitat. Heavy woods and forests.

Distribution in New York. The range of the smoky shrew in New York coincides very closely with that of the common red-backed mouse and the Canadian white-footed mouse. The animal is abundant

throughout the heavily forested boreal area in the northern part of the state. South of this region it occurs in isolated colonies wherever local conditions give it a sufficiently boreal environment.

Principal records. Merriam: "This species . . . is not rare in the Adirondacks though I do not think it is as plentiful here as *Sorex cooperi* [*personatus*], which it much resembles in habits" ('84d, p. 77). Mearns: "Three specimens were taken [in the Catskills]. One was trapped under a stone wall on the right [north] bank of Schoharie creek, one in a hollow stump on the south slope of East Jewett mountain at about 2000 feet altitude, and the third under a log a little farther up the mountain" ('98b, p. 354).

I have found the smoky shrew at Peterboro and Chittenango falls, Madison co. and at Elizabethtown, Essex co. ('95, p. 50-52). At the type locality it is local and not common. Most of the specimens including the type were trapped in a gorge on the Oneida creek about three miles southwest of the village of Peterboro. At Elizabethtown it is common and very generally distributed in the forests.

Remarks. This species will probably be found in many localities in New York. Rhoads has recorded it from the following counties in Pennsylvania: Pike, Monroe, Sullivan, Clinton, Columbia and Somerset ('97b, p. 223).

Sorex macrurus Batchelder *Big-tailed shrew*

1896 *Sorex macrurus* Batchelder, Biolog. soc. Washington. Proc. 8 Dec. 1896. 10: 33.

1898 *Sorex macrurus* Mearns, U. S. Nat. mus. Proc. 21: 355.

Type locality. Beedes, Essex co. New York.

Faunal position. The big-tailed shrew is so slightly known that I am unable to assign it a definite faunal position. In all probability it is confined to the colder parts of the boreal zone.

Habitat. (See principal records).

Distribution in New York. The only localities at which this animal has been taken are Beedes, the summit of Mt Marcy and the Catskills. In all only 10 specimens have yet been collected.

Principal records. Batchelder: "On September 9, 1895 at Beedes, Essex co. New York I obtained a shrew unlike any species known to me. It was caught . . . among some large angular rocks at the head of a wooded talus of loose rock. Just above, shading the spot and keeping it moist and cool, rise the low cliffs from whose fragments the talus has been formed.

"Nearly a year later on August 1, 1896 I caught a second specimen of this shrew on Mt Marcy, the highest of the Adirondack mountains . . . It was taken in a crevice between some rocks on the bare open summit of the mountain about 5300 feet above sea-level. The locality where the first one was captured is about eight miles distant in an air line and lies at an elevation of only 1300 feet above the sea" ('96b, p. 133).

Mearns: "The [eight] specimens were trapped in hollows under mossy stones and stumps usually in wet balsam or spruce woods or in weedy swamps. The lowest place where it was taken was in a balsam swamp at about 3700 feet altitude, others were caught somewhat higher in a sparsely wooded swamp densely overgrown with asters (*Aster puniceus*) then in bloom, and four were trapped on the top of Hunter mountain (altitude 4025 feet)" ('98b p. 356).

Sorex personatus I. Geoffroy St Hilaire *Masked shrew*

1827 *Sorex personatus* I Geoffroy St Hilaire, Mem. du mus. d'hist. nat. Paris. 15: 122.

1842 *Sorex forsteri* De Kay, Zoology of New York, Mammalia. p. 40.

1842 *Otisorex platyrhinus* De Kay, Zoology of New York, Mammalia. p. 22.

1884 *Sorex cooperi* Merriam, Linn. soc. New York. Trans. 2: 75.

1895 *Sorex personatus* Miller, North American fauna. no. 10. 31 Dec. 1895. p. 53.

1896 *Sorex personatus* Fisher, The Observer. May 1896. 7: 194.

1898 *Sorex personatus* Mearns, U. S. Nat. mus. Proc. 21: 355.

1898 *Sorex personatus* Mearns, Am. mus. nat. hist. Bul. 9 Sep. 1898. 10: 343.

Type locality. Eastern United States possibly somewhere in New York.

Faunal position. Boreal and transition zones; cool localities in upper austral zone.

Habitat. Open or wooded places both wet and dry.

Distribution in New York. The masked shrew probably occurs throughout the state.

Principal records. De Kay: "They are found in all parts of the state" ('42, p. 21). Merriam: "This diminutive shrew, the smallest known mammalian inhabitant of the Adirondacks, is quite common in most parts of the region but much more abundant some years than others" ('84d, p. 75). Fisher: "The common shrew is rather rare and is the only one of the long-tailed species found in the neighborhood [of Sing Sing]. Its scarcity however may be only apparent and due wholly

or in part to our lack of skill in former days in trapping it successfully" ('96, p. 194). Mearns: "Two specimens were trapped, the first . . . in a balsam swamp at 3700 feet altitude and the second . . . on the actual summit of Hunter mountain" ('98b, p. 355).

I have found the masked shrew common at Peterboro, Madison co. and Elizabethtown, Essex co. In both localities it is generally distributed.

Mr Savage writes: "*Sorex personatus* is abundant in the low flat land known as the 'Tifft farm' near Buffalo. Here I have frequently heard them squeaking all around me."

Of the masked shrew Mr Helme writes: "This diminutive mammal is not rare in most parts of Long Island. It builds a small spherical nest of dry leaves in some cavity under a log or old stump. I once found six specimens under an old log in a nest of leaves and bits of dry seaweed."

Sorex hoyi Baird *Hoy's shrew*

1858 *Sorex hoyi* Baird, Mamm. N. Am. p. 32.

1895 *Sorex hoyi* Merriam, North American fauna. no. 10. 31 Dec. 1895. p. 89.

Type locality. Racine, Wisconsin.

Faunal position. Hoy's shrew is probably an inhabitant of the transition and boreal zones. Its faunal position is not well understood.

Habitat This animal is so little known that its habitat cannot be definitely stated. Apparently it is more often found in cleared land than in woods or forests (see Miller, 97b, p. 37).

Distribution in New York. While this species probably occurs throughout the northern half of the state it has as yet been taken at Locust Grove, Lewis co. only (Merriam, '95, p. 90).

Blarina brevicauda (Say) *Short-tailed shrew*

1823 *Sorex brevicaudus* Say, Long's exped. to the Rocky mts.

1837 *Sorex dekayi* Bachman, Acad. nat. sci. Philadelphia. Jour. pt. 2. 7: 377.

1842 *Sorex dekayi* De Kay, Zoology of New York, Mammalia. p. 17 (part).

1842 *Sorex brevicaudus* De Kay, Zoology of New York, Mammalia. p. 18 (part).

1842 *Sorex carolinensis* De Kay, Zoology of New York, Mammalia. p. 21 (part).

1858 *Blarina brevicauda* Baird, Mamm. N. Am. p. 42 (part).
1858 *Blarina talpoides* Baird, Mamm. N. Am. p. 37 (part).
1884 *Blarina brevicauda* Merriam, Linn. soc. New York. Trans. 1884. 2 : 66.
1896 *Blarina brevicauda* Fisher, The Observer. May 1896. 7 : 194.
1898 *Blarina brevicauda* Mearns, Am. mus. nat. hist. Bul. 9 Sep. 1898. 10 : 343.
1898 *Blarina brevicauda* Mearns, U. S. Nat. mus. Proc. 21 : 356.

Type locality. Near Blair, Nebraska.

Faunal position. Boreal transition and upper austral zones.

Habitat. Fields and woods, wet or dry marshes, borders of streams. Every variety of country appears to be equally attractive to this animal.

Distribution in New York. The short-tailed shrew is one of the most abundant and widely distributed of the mammals that occur in the state. There are probably very few square miles in New York not inhabited by hundreds of individuals.

Principal records. De Kay: "This shrew is found in Albany county and in the southern parts of the state" ('42, p. 18) . . . "I have had an opportunity of examining a recent specimen from Queens co. which I refer to this species" ('42, p. 19). "[This shrew is] commonly found in this state" ('42, p. 21). Merriam: "The short-tailed shrew is, I presume, the most abundant of the insectivorous mammals that occur in the Adirondack mountains, and is found alike in the dense coniferous forests of the interior and the cleared and settled districts of the surrounding region" ('84d, p. 66). Fisher: "A common species [in the neighborhood of Sing Sing]. Almost everywhere in the woods its tunnels may be found running hither and thither under the matting of dry leaves or old decayed logs. In the open meadows it is less common though occasionally found, attracted there no doubt by the meadow mice or other favorite food" ('96, p. 194). Mearns: "Very abundant from Schoharie creek up to the higher mountain tops where it appears to be less numerous though several were taken on the summit of Hunter mountain" ('98b, p. 356).

I have found the short-tailed shrew abundant at Geneva, Ontario co. Peterboro, Madison co. and Elizabethtown, Essex co.

Mr Savage writes that he has taken three or four specimens near Buffalo.

According to Mr Helme the short-tailed shrew is very common on Long Island.

Remarks. The small *Blarina parva* [a] Say undoubtedly occurs in the lower Hudson valley though it has not to my knowledge been taken within the limits of the state.

De Kay included the animal on the ground of its occurrence in Connecticut ('42, p. 20). Mr Frank M. Chapman writes me that there is in the American museum of natural history a specimen of this shrew taken on the Hackensack marshes in New Jersey only a few miles from the New York state line. The species is to be looked for also in the upper austral area at the extreme western part of the state.

Scalops aquaticus (Linnaeus) *Naked-tailed mole*

1758 *Sorex aquaticus* Linnaeus, Syst. nat. ed. 10. 1 : 53.
1825 *Scalops acquaticus* F. Cuvier, Dents des Mamm. p. 251
1842 *Scalops aquaticus* De Kay, Zoology of New York, Mammalia p. 15 (part).
1884 *Scalops aquaticus* Merriam, Linn. soc. New York. Trans. 2 : 55.
1896 *Scalops aquaticus* Fisher, The Observer. May 1896. 7 : 194.
1898 *Scalops aquaticus* Mearns, Am. mus. nat. hist. Bul. 9 Sep. 1898. 10 : 343.

Type locality. Eastern United States.

Faunal position. Transition zone and austral zones.

Habitat. Dry, sandy soil.

Distribution in New York. The naked-tailed mole may be looked for in New York in suitable localities anywhere outside of the limits of the boreal zone. The details of its distribution in the state are unknown.

Principal records. De Kay : "The shrew-mole has a wide geographic range, being found from Carolina to the 50th degree of north latitude, and from the Atlantic to the shores of the Pacific" ('42, p. 17). Merriam : "This species is not common about the borders of the Adirondacks and is seldom if ever found within the evergreen forests, though it sometimes finds its way to the frontier settler's garden" ('84d, p. 55). Fisher : "Common in the meadows and lawns [about Sing Sing]" ('96, p. 194).

Mr Helme writes that the naked-tailed mole is common on Long Island.

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a 1823 *Sorex parvus* Say, Long's exped. to the Rocky mts. 1 : 164.
1842 *Sorex parvus* De Kay, Zoology of New York, Mammalia. p. 19.
1895 *Blarina parva* Merriam, North American fauna, no. 10. 31 Dec. 1895. p. 17.
Type locality. Near Blair, Nebraska.
Faunal position. Upper and lower austral zones.
Distribution. Upper and lower austral zones from the Mississippi valley to the Atlantic coast.

Remarks. De Kay's account of *Scalops aquaticus* clearly refers in part to the hairy-tailed mole since he records one specimen with 44 teeth.

Parascalops breweri (Bachman) *Hairy-tailed mole*

1842 *Scalops aquaticus* De Kay, Zoology of New York, Mammalia. p. 15 (part).

1844 *Scalops breweri* Bachman, Boston journ. nat. hist. 4 : 32.

1855 *Scalops breweri* Baird, N. Y. State cab. nat. hist. 15th rep. Append. A. p. 1.

1884 *Scapanus americanus* Merriam, Linn. soc. New York. Trans. 2 : 63.

1895 *Parascalops breweri* True, Science, N. S. 25 Jan. 1895. 1 : 101.

1898 *Parascalops breweri* Mearns, Am. mus. nat. hist. Bul. 9 Sep. 1898. 10 : 343.

1898 *Parascalops breweri* Mearns, U. S. Nat. mus. Proc. 21 : 357.

Type locality. The type specimen of *Scalops breweri* was supposed to have been taken on the island of Marthas vineyard, Massachusetts (see Bachman, '44) but this is doubtless an error.

Faunal position. Boreal zone and perhaps northern part of transition zone.

Distribution in New York. The range of the hairy-tailed mole in New York is not well understood at present. The animal is probably common in open country throughout the northern half of the state. It also occurs in the Catskills and in the Hudson highlands. In his *Revision of the American moles* Mr F. W. True says: "All the New York specimens examined were from Lewis and Oneida counties, in the northwestern part of the state, but Bachman had 4 specimens from Troy, Rensselaer co. [Audubon and Bachman '51, p. 175]. No specimens have been taken in any part of southern or southeastern New York so far as I am aware" ('96, p. 73).

Principal records. De Kay: (A specimen of *Scalops aquaticus* with 44 teeth is mentioned ('42, p. 15–16), but no locality stated). Baird: "This species of mole, although not mentioned by De Kay in the State natural history, is in reality very abundantly to be met with in the northern part of the state and apparently to the exclusion of the more southern species with white naked tail, *S. aquaticus* ('65, p. 1). Merriam: "I have secured a number of examples of this species from the borders of the wilderness, but have not observed it within the coniferous forests" ('84d, p. 63). Mearns: "This mole is probably rare in the [Hudson] highlands though common in the Catskill mountains. I have examined

only two specimens. The first was picked up under a haypole on a salt-marsh beside the Hudson and identified by Dr C. Hart Merriam. On June 28, 1878, Mr William Church Osborn brought me a perfect albino specimen of this mole which a gardener had caught near Garrison's in Putnam co." ('98a, p. 343–44). "One specimen taken [in the Schoharie valley]" ('98b, p. 357).

I have found the hairy-tailed mole tolerably common at Peterboro, Madison co. and Elizabethtown, Essex co.

Mr Savage has not found the animal at Buffalo, but I have seen a specimen belonging to Ward's natural science establishment taken near Rochester.

Condylura cristata (Linnaeus) *Star-nosed mole*

1758 [*Sorex*] *cristatus* Linnaeus, Syst. nat. ed. 10. 1 : 53.
1819 *Condylura cristata* Desmarest, Jour. de Physique. 89 : 230.
1842 *Condylura cristata* De Kay, Zoology of New York, Mammalia. p. 14.
1884 *Condylura cristata* Merriam, Linn. soc. New York. Trans. 2 : 48.
1896 *Condylura cristata* Fisher, The Observer. May 1896. 7 : 195.
1898 *Condylura cristata* Mearns, Am. mus. nat. hist. Bul. 10 : 344.

Type locality. Pennsylvania.

Faunal position. The star-nosed mole is a member of the boreal fauna, but it ranges far south of the limits of the boreal zone in cool, damp situations.

Habitat. Swamps and soft damp ground. The tunnels inhabited by the star-nosed mole are often found partly filled with water. In its semi-aquatic habits this species differs strikingly from the two other moles found in New York.

Distribution in New York. This species is the most widely distributed of the moles that occur in the state. It is probably an inhabitant of every county. The exact details of its range however remain to be determined.

Principal records. De Kay: "The star-nose is abundant throughout New York." ('42. p. 14). Merriam: "The star-nosed mole is a common animal along the outskirts of the Adirondacks, where it seems to manifest a predilection for moist situations" . . . ('84d, p. 48). Fisher: "The star-nosed mole is far less common than the preceding species [*Scalops aquaticus*], and usually inhabits wet meadows near streams though occasionally taken in dry soil" ('96, p. 195). Mearns: "This singular-looking animal is not uncommon [in the Hudson highlands]" ('98a, p. 344).

I have found the star-nosed mole common at Geneva, Ontario co.; Peterboro, Madison co. and Elizabethtown, Essex co.

Mr Savage writes that this species is not rare in the neighborhood of Buffalo, though less numerous than the naked-tailed mole.

"Several years ago I found a specimen lying dead in the street at Miller place, Long Island. This is my only record for the region" (Helme).

Myotis lucifugus (Le Conte) *Little brown bat*

1831 *Vespertilio lucifugus* Le Conte, McMurtrie's Cuvier, Animal kingdom. Append. 1: 431.

1842 *Vespertilio subulatus* De Kay, Zoology of New York, Mammalia. p. 8 (part).

1864 *Vespertilio lucifugus* H. Allen, Monogr. bats N. Am. p. 55.

1884 *Vespertilio subulatus* Merriam, Linn soc. New York. Trans. 2: 96 (part).

1893 *Vespertilio gryphus* Var. (a) *Vespertilio gryphus lucifugus*, H. Allen, Monogr. bats N. Am. p. 78.

1896 *Vespertilio lucifugus* Fisher, The Observer. 7: 195.

1897 *Myotis lucifugus* Miller, North American fauna. no. 13. p. 59.

1898 *Myotis lucifugus* Mearns, U. S. Nat. mus. Proc. 21: 357.

Type locality. Southern Georgia.

Faunal position. The little brown bat ranges from Florida to Alaska, or throughout the breadth of five life zones. Such a distribution is very difficult to understand in the absence of definite knowledge of the real climatic conditions to which the animal is exposed during its breeding season.

Habitat. Caves, hollow trees and crevices in buildings. Dr Harrison Allen refers to this bat as "a strictly pastoral species" which "is not collected in houses either in town or country" ('93, p. 84). This statement is very misleading as the little brown bat often takes up its abode in buildings where it occasionally becomes a serious pest. This is the common bat of the Mammoth cave (Rhodes, '97b, p. 59).

Distribution in New York. As might be expected from its wide range, the little brown bat occurs throughout New York state. It is not equally common in all localities however, and the details of its local distribution remain to be worked out.

Principal records. De Kay: (Mentioned as a common species. The account probably refers partly to this animal and partly to *M. subulatus*. '42, p. 9). Merriam: "Next to the silver-haired bat this is the commonest and most universally distributed species in the Adirondacks, so

far as my observations have extended. Professor Baird has taken the typical animal at Elizabethtown, and the form known as *lucifugus* at Westport" ('84, p. 96). Fisher: "Out of the hundreds of bats collected only one of this species was ever secured" ('96, p. 195). Miller: "The species is recorded from Adirondacks, Big moose lake, Catskill mountains, Howe's cave, Lake George, Locust grove, Lyons falls, Oneida lake, Peterboro, Sing Sing and West point" ('97, p. 62). Mearns: "This was the commonest bat in the Catskills and seen nightly" ('98b, p. 357).

I have found the little brown bat excessively abundant near the southeast shore of Oneida lake. Here it occurred in large colonies between rafters in barns and under the roofs and loose clapboards of old houses. At Peterboro the animal though less numerous than at Oneida lake, is common.

Mr Savage has taken a small brown bat, in a cave in the Niagara river gorge near the Devil's hole, which with some doubt he refers to this species.

Myotis subulatus (Say) *Say's bat*

1823 *? Vespertilio subulatus* Say, Long's exped. to the Rocky mts 2 : 65 footnote.

1842 *Vespertilio subulatus* De Kay, Zoology of New York, Mammalia. p. 8 (part).

1864 *Vespertilio subulatus* H. Allen, Monogr. bats N. Am. p. 51.

1884 *Vespertilio subulatus* Merriam, Linn. soc. New York. Trans. 2 : 96 (part).

1893 Northern form of *Vespertilio gryphus* H. Allen, Monogr. bats N. Am. p. 80.

1897 *Myotis subulatus* Miller, North American fauna. no. 13. p. 75.

1898 *Myotis subulatus* Mearns, Am. mus. nat. hist. Bul. 9 Sep. 1898. 10 : 344.

Type locality. Arkansas river, near La Junta, Colorado.

Faunal position. Too little is known of the range of this bat to permit the species to be assigned any definite faunal position. At present it is known to occur in the boreal, transition and upper austral zones.

Habitat. Probably similar to the little brown bat.

Distribution in New York. Say's bat probably occurs throughout the state but the details of its distribution are unknown.

Principal records. De Kay: (The account given by De Kay doubtless refers in part to this species) H. Allen: Specimen recorded from Elizabethtown, Essex co. ('64, p. 53). This is the first definite New

York record. Merriam: Reference made to the Elizabethtown specimen previously recorded by Harrison Allen ('84, p. 96). Miller: Specimens mentioned from Hammondville, Hemlock lake, Highland falls, Lake George and Peterboro ('97c, p. 76). Mearns: "This bat is quite uncommon in the Hudson highlands" ('98a, p. 344).

I have taken a few specimens of Say's bat at Peterboro, Madison co. where it is much less common than the little brown bat.

Lasionycteris noctivagans (Le Conte) *Silvery bat*

1831 *Vespertilio noctivagans* Le Conte, McMurtrie's Cuvier, Animal kingdom. June 1831. 1:31.

1831 *Vespertilio auduboni* Harlan, Monthly Amer. journ. geol. and nat. hist. Nov. 1831. 1:220.

1842 *Vespertilio noctivagans* De Kay, Zoology of New York, Mammalia. p. 9.

1864 *Scotophilus noctivagans* H. Allen, Monogr. bats N. Am. p. 39.

1865 *Lasionycteris noctivagans* Peters, Monatsber. K. Preuss. Akad. Wissensch. Berlin. p. 648.

1884 *Vesperugo noctivagans* Merriam, Linn. soc. New York. Trans. 2:90.

1893 *Lasionycteris noctivagans* H. Allen, Monogr. bats N. Am. p. 105.

1896 *Vesperugo noctivagans* Fisher, The Observer. May 1896. 7:195.

1897 *Lasionycteris noctivagans* Miller, North American fauna. no. 13. 16 Oct. 1897. p. 86.

1898 *Lasionycteris noctivagans* Mearns, Am. mus. nat. hist. Bul. 9 Sep. 1898. 10:345.

Type locality. Eastern United States.

Faunal position. Boreal transition and northern edge of upper austral zones.

Distribution in New York. The silvery bat is found either as a migrant or summer resident throughout the state. While its breeding range scarcely reaches the upper limit of the upper austral zone, its migrations carry it to the Bermudas and to the extreme southern United States (see Merriam, '88, p. 85 and Miller, '97a, p. 543).

Principal records. De Kay: "The silver-haired bat is common on Long Island and the southern counties of the state" ('42, p. 10). Merriam: "This is our commonest bat, far outnumbering all the other species together. I have killed it in various parts of the wilderness, and during the past summer . . . shot over 125 in Lewis co. . . ." ('84d, p. 90). Fisher: "Tolerably common [near Sing Sing] . . . On June 24,

1884, Mr Howard Acker found 16 females with 25 young from one to three days old under the siding of an old house" ('96, p. 196). Mearns: "One specimen was taken from a hollow tree [at Highland falls]" ('98a, p. 345).

Mr Helme writes that the silvery bat is very common on Long Island.

Pipistrellus subflavus subflavus (F. Cuvier) *Georgia bat*

1834 *? Vespertilio georgianus* F. Cuvier, Nouv. ann. d'hist. nat. Paris 2:16 (not determinable).

1834 *Vespertilio subflavus* F. Cuvier, Nouv. ann. d'hist. nat. Paris. 1:17.

1864 *Scotophilus georgianus* H. Allen, Monogr. bats N. Am. p. 35.

1893 *Vesperugo carolinensis* H. Allen, Monogr. bats N. Am. p. 121.

1896 *Vesperugo georgianus* Fisher, The Observer. May 1896. 7:196.

1897 *Pipistrellus subflavus* Miller, North American fauna. no. 13. p. 90.

1898 *Pipistrellus subflavus* Mearns, Am. mus. nat. hist. Bul. 10:345.

Type locality. Eastern United States; probably Georgia.

Faunal position. Austral zones and lower edge of transition zone.

Distribution in New York. The Georgia bat is abundant in the lower Hudson valley but is not as yet known in other parts of the state.

Principal records. Fisher: "The commonest bat [at Sing Sing]. On warm summer evenings . . . hundreds may be seen flying back and forth over fields or lakes busily engaged in collecting their diminutive prey" ('96, p. 196). Mearns: "This bat is not abundant in the [Hudson] highlands" ('98a, p. 345).

I have taken one specimen of *Pipistrellus* at Peterboro, Madison co., but as it is immature I am unable to refer it satisfactorily either to the typical form or to *P. subflavus obscurus.*

Pipistrellus subflavus obscurus Miller *Dusky bat*

1897 *Pipistrellus subflavus obscurer* Miller, North American fauna. no. 13. 16 Oct. 1897. p. 93.

Type locality. Lake George, Warren co. New York.

Faunal position. Probably the border line between transition zone and upper austral zone.

Distribution in New York. This bat has been found at the type locality only.

Principal records. Miller: 34 specimens recorded ('97c, p. 93).

Vespertilio fuscus Beauvois *Brown bat*

1796 *Vespertilio fuscus* Beauvois, Cat. Peale's museum. p. 14.

1842 *Vespertilio carolinensis* De Kay, Zoology of New York, Mammalia. p. 10.

1864 *Scotophilus fuscus* H. Allen, Monogr. bats N. Am, p. 31.

1884 *Vesperugo serotinus fuscus* Merriam, Linn. soc. New York. Trans. 2:86.

1893 *Adelonycteris fuscus* H. Allen, Monogr. bats N. Am. p. 112.

1896 *Vesperugo fuscus* Fisher, The Observer. May 1896. 7:195.

1897 *Vespertilio fuscus* Miller, North American fauna. no. 13. 16 Oct. 1897. p. 96.

1898 *Vespertilio fuscus* Mearns, Am. mus. nat. hist. Bul. 9 Sep. 1898. 10:344.

1893 *Vespertilio fuscus* Mearns, U. S. Nat. mus. Proc. 21:357.

Type locality. Philadelphia, Pa.

Faunal position. Austral zones and transition zone.

Habitat. Caves, hollow trees and crevices in buildings. This bat is usually very common in towns and cities.

Distribution in New York. The brown bat occurs throughout the non-boreal part of the state. The details of its distribution are not yet known.

Principal records. De Kay: "I have obtained it from Kings co. and Prof. Emmons has observed it at Albany in the months of February and March" ('42, p. 11). Merriam: "Professor Baird has taken this species at Westport in Essex co. on the eastern border of the Adirondacks and I have procured a single specimen in Lewis co. on the western side of the district, but it is unquestionably the rarest bat found within the limits of the region" (84d, p. 86) Fisher: "Common [at Sing Sing]" ('96, p. 195). Mearns: "The big brown bat is very common [at Highland falls], often entering houses in pursuit of insects" ('98a, p. 344). "Common [near Kaaterskill junction]" ('98b, p. 357).

I have never met with this bat in New York.

Mr Savage writes: "The brown bat has been taken here on one occasion at least. Some time ago one of the pupils of the Central high school took a live specimen to Dr F. W. Barrows who had it mounted. I have recently examined the specimen."

Lasiurus cinereus (Beauvois) *Hoary bat*

1796 *Vespertilio linereus* Beauvois, Cat. Peale's museum. p. 14 (obvious misprint for *cinereus*).

1842 *Vespertilio pruinosus* De Kay, Zoology of New York, Mammalia. p. 7.

1864 *Lasiurus cinereus* H. Allen, Monogr. bats N. Am. p. 21.
1884 *Atalapha cinerea* Merriam, Linn. soc. New York. Trans. 2:78.
1893 *Atalapha cinerea* H. Allen, Monogr. bats N. Am. p. 155.
1896 *Atalapha cinerea* Fisher, The Observer. May 1896. 7:196.
1897 *Lasiurus cinereus* Miller, North American fauna. no. 13. 16 Oct. 1897. p. 112.

Type locality. Philadelphia, Pa.

Faunal position. The breeding range of the hoary bat appears to be strictly confined to the boreal zone.

Habitat. Forests and woodlands except during migrations when the animal may be found anywhere.

Distribution in New York. So far as known this bat does not occur outside of the boreal area in the Adirondacks during the breeding season. Its migrations carry the animal far south of the boundaries of the state (Merriam, '88, p. 85; Miller, '97a, p. 542-43).

Principal records. De Kay: (The hoary bat regarded as uncommon ('42, p. 9). Merriam: "This species . . . is not rare in the Adirondacks, and I have taken it both in the interior and along the western border of the region" ('84d, p. 78.) Fisher: "On the evening of October 1, 1883 one of these beautiful bats was seen flying about a lawn, [at Sing Sing] where it was well identified" ('96, p. 196).

Of this species in the vicinity of Buffalo Mr Savage writes, "The hoary bat also occurs but in what numbers I am unable to say. There is a good specimen in the museum of the Buffalo society of natural sciences.

"Rare on Long Island. Has been taken in August, September and October" (Helme).

Lasiurus borealis (Müller) *Red bat*

1776 *Vespertilio borealis* Müller, Natursyst. Suppl. p. 20.
1842 *Vespertilio noveboracensis* De Kay, Zoology of New York, Mammalia. p. 6.
1864 *Lasiurus noveboracensis* H. Allen, Monogr. bats N. Am. p. 51.
1884 *Atalapha noveboracensis* Merriam, Linn. soc. New York. Trans. 2:83.
1893 *Atalapha noveboracensis* H. Allen, Monogr. bats N. Am. p. 142.
1896 *Atalapha borealis* Fisher, The Observer. May 1896. 7:196.
1897 *Lasiurus borealis* Miller, North American fauna. no. 13. 16 Oct. 1897. p. 106.
1898 *Lasiurus borealis* Mearns, Am. mus. nat. hist. Bul. 9 Sep. 1898. 10:345.

Type locality. New York state.

Faunal position. The red bat breeds throughout the austral zones, the transition zone and the lower part of the boreal zone.

Habitat. Forests, woodlands, groves and parks. The red bat appears to be an almost exclusively arboreal species.

Distribution in New York. The red bat probably occurs commonly throughout New York state, except, perhaps, in the central part of the Adirondack region. This species is extensively migratory (Merriam, '88 p. 85; Miller, '97a, p. 541–42; Mearns, '98a, p. 345).

Principal records. De Kay: "This is the most common species in our state" ('42, p. 6). Merriam: "This species ranks among the least common bats of the area under consideration" ('84d, p. 83). Fisher: "Next to the little Georgian bat the red bat is the commonest species [in the neighborhood of Sing Sing]" ('96, p. 196). Mearns: "Very abundant in this region [the Hudson highlands] during the summer . . . During the latter part of October and the first week of November, I have seen great flights of them during the whole day" ('98a, p. 345).

I have found the red bat a common summer resident at Peterboro, Madison co.

Mr Savage writes that, of the bats that occur in the neighborhood of Buffalo, the red bat appears to be the most numerous.

Mr Helme reports that this species is the commonest bat on Long Island.

Addenda

The following papers should be mentioned which were overlooked in preparing the body of this paper:

De Kay, J. E. Assembly document 161, 1837. New York geological and mineralogical reports for 1836, p. 13–15. In this communication it is estimated that 60 different species of mammals occur in the state.

De Kay, J. E. Assembly document 50, 1840. New York geological and mineralogical reports for 1839, p. 7–36. In this article 74 mammals are mentioned as occurring in the state. The list here given includes introduced and fossil forms, also a number of synonyms, several species that are mentioned without positive knowledge of their occurrence in this state and some few that prove to have been founded on insufficient characters, making the number of New York mammals then known less than 60.

F.J.H.M.

Fossil species

Platigonus compressus Le Conte *Fossil peccary*

1848 *Platigonus compressus* Le Conte, Am. jour. sci. and arts. ser. 2. 5 : 103.

1889 *Platygonus compressus* Leidy, Wagner free inst. of science of Philadelphia. Trans. Dec. 1889. 2 : 47.

Type locality. "The lead region of Illinois" (Le Conte, '48, p. 102).

Distribution in New York. Bones of the fossil peccary have been found near Rochester, but at no other locality in the state to my knowledge.

Principal records. Leidy: "Recently the writer procured through purchase for the Academy of natural sciences of Philadelphia . . . a collection of remarkably well-preserved remains of two adult individuals of *Platygonus compressus* which were found in making a railway excavation in a gravel bank a few miles from Rochester. Of one individual there is the greater part of the skeleton, consisting of the nearly perfect skull with the teeth . . . 21 vertebrae, the sacrum, the long bones of both pairs of limbs, the imperfect scapulae, an innominatum, and part of a second, both pairs of principal metacarpals, one pair of principal metatarsals, an astragalus, a calcaneum, portions of a sternum and fragments of three ribs. Of the second individual there is a less perfect skull with the upper teeth but without the mandible" ('89, 41).

Equus major De Kay *Fossil horse*

1842 *Equus major* De Kay, Zoology of New York, Mammalia. p. 108.

1884 *Equus major* Merriam, Linn. soc. New York. Trans. Aug. 1884. 2 : 47.

Type locality. Navesink hills, New Jersey.

Distribution in New York. Remains of the fossil horse have been found at Keene's station, near the Oswegatchie river Ox Bow, in Jefferson co.

Principal records. De Kay: "Teeth and bones of the horse have been found in various parts of the Union, but I am unacquainted with any locality in this state. The nearest approach to it are the teeth and vertebrae found near the Navesink hills in New Jersey. . . They have also been found on the north branch of the Susquehannah; in digging the Chesapeake canal near Georgetown D. C. and in North Carolina 16 miles below Newbern" ('42, p. 108). Merriam: Dr C. C. Benton of Ogdensburg has shown me several fossil molar teeth of *Equus maior*

that were exhumed at Keene's station near the Oswegatchie Ox Bow in Jefferson co. I have compared them with the corresponding teeth in an immense dray-horse, and find them much larger" ('84, p.).

Elephas columbi Falconer *Fossil elephant*

1842 *Elephas americanus* De Kay, Zoology of New York, Mammalia. p. 101. Not *Elephas americanus* Kerr, 1792.

1857 *Elephas columbi* Falconer, Quart. journ. geol. soc. London. v. 13, table facing p. 319.

Type locality. Mexico and the southern United States.

Distribution in New York. Remains of the fossil elephant may be looked for in marl beds, gravel banks and similar locations anywhere in New York. They are much less abundant however than those of the mastodon.

Principal records. De Kay: "The specimens . . . were found in a diluvial formation near the Irondiquoit river in Monroe county 10 miles east of the city of Rochester . . . these consisted of a tusk and two molars" ('42, p. 101).

Mastodon americanus Kerr *American mastodon*

1792 *Elephas americanus* Kerr, Animal kingdom. 1 : 116.

1842 *Mastodon maximus* De Kay, Zoology of New York, Mammalia. p. 102.

1895 *Mastodon americanus* Allen, Am. mus. nat. hist. Bul. 20 June 1895. 7 : 187.

Type locality. Big bone lick, Kentucky.

Distribution in New York. Like the fossil elephant the mastodon once occurred throughout the state. Its remains are more abundant than those of the elephant.

Principal records. De Kay, "In this state the remains of this animal were discovered near Claverack, as early as 1705, and formed the subject of a note from the celebrated Dr Mather, which appeared in the *English philosophical transactions*, 1705, July 23.

"In 1782, they [bones of the mastodon] were found in a swamp, near Montgomery, Orange co., and in greater numbers at Shawangunk, Ulster co. Shortly after, portions of eight distinct individuals were discovered within eight or 10 miles of Montgomery. In 1801, Mr Peale succeeded in disinterring, from this region, an almost entire skeleton.

"Since that period, other localities have been discovered, the most remarkable of these are,

1 From Rockland county, in 1817; and from Chester, Orange co. . . .

2 In the same year, remains were found in the city of Rochester, 4 feet below the surface, in a hollow or water course.

3 In 1823, more than one half of a lower jaw, with the teeth, on the shore of Long-Island, between high and low water mark, about four miles east of the county court-house at Riverhead, Suffolk co. . . . It may be noted that a very large molar, in Dr Morton's collection, was fished up from a similar locality, namely, in the ocean at Long Branch, N. J. . . .

4 At Geneseo, Livingston co. (see *Am. jour.* 12 : 381) the greater part of a skeleton was found in a marsh 2½ feet below the surface, in vegetable mould, and resting upon a bed of fine white gravel.

5 In 1834, the molar tooth of this species was found near Jamestown, Chautauqua co.

6 A fine portion of the lower jaw of a young mastodon, from the town of Montgomery, Orange co. . . .

7 In the town of Shawangunk, Ulster co.

8 At Perrinton, near Rochester, Monroe co.

9 At Coeymans, Albany co.

10 At Hinsdale, Cattaraugus co, a tusk was found 17 feet beneath the surface. The soil was composed of alternate strata of sand and gravel.

11 In 1841, in a bed of marl three miles south of Le Roy, [a tooth ?] weighing two pounds.

12 A tooth was found in digging a mill-race on Goat Island, Niagara co., 12 or 13 feet below the surface" ('42, p. 103–4).

The remains of numerous mastodons have been found in New York since 1842, but it is hardly necessary to bring together a complete list.

Warren ('52) records a nearly complete skeleton discovered near Newburgh in 1845.

Hall ('71) records a skeleton, likewise essentially perfect, from Cohoes. He says: "In the month of September 1866 the workmen engaged in excavations for the foundation of a new mill to be erected by the "Harmony mills co. of Cohoes, N Y." discovered the lower jaw of a mastodon with a single foot bone, resting upon a projection of rock between two depressions or concave walls of small pot-holes in the margin of what afterward proved to be a larger pot-hole" ('71, p. 99). Further excavations brought to light the remainder of the skeleton, some parts of which lay 60 feet away from the spot where the jaw was found. This specimen is in the N. Y. state museum.

Clarke ('88) reports the discovery of bones of a mastodon or elephant (probably the former) in the village of Attica, Wyoming co. This specimen is specially interesting on account of its close association with human relics.

Marsh ('92) describes a skeleton in the museum of Yale university which is "perhaps in the best preservation of any skeleton of the American mastodon yet discovered." I am informed, however, that it lacks the hind legs. Dana ('95, p. 999) states that this skeleton was found at Otisville, Orange co.

The Newburgh mastodon. "The mastodon discovered about two months ago at Newburgh, N. Y., has now been more fully uncovered, but thus far proves to be an incomplete skeleton. The parts preserved are the skull, much injured by removal, both upper tusks, the vertebrae beginning at the last cervical and extending to near the tip of the tail, 18 ribs on each side out of 20, a right scapula and a complete pelvis and portions of the foot bones. No traces of the limbs have been found thus far, although extensive excavations have been made. Fortunately, Mr Schaefer, the owner, has removed the bones with care and treated them skilfully. Many very interesting observations could be made by a careful study and exploration of this locality. During a visit by the present writer, the following observations were made, partly with the aid of Mr Schaefer. The deposition is in three levels, the two upper being separated by a smooth clearly defined surface, and by slight differences in the character of the soil, which is largely dark and thoroughly decomposed vegetable matter, intermingled with few stones and very numerous remains of trees of various sizes. Examination of the latter gives abundant evidence of the existence of beaver in this hollow in the period of the mastodon, and we can easily imagine that the different soil levels were due to the building of successive beaver dams. When the dams were first completed the back flow of the water caused temporarily an interruption of the deposition of vegetation and may account for the differences of level above alluded to. The locality has been visited by a large number of people, including several well known paleontologists." —H. F. Osborn.

Castoroides ohioensis Foster

1838 *Castoroides ohioensis* Foster, Second annual report on the geological survey of Ohio. 1838. p. 81.

1847 *Castoroides ohioensis* Hall, Boston journ. nat. hist. 5 : 385.

Type locality. "About one-half of a mile west of Nashport [Ohio]" (Foster, '38, p. 80).

Distribution in New York. Remains of *Castoroides ohioensis* have been found only once in New York — in a swamp near Clyde, Wayne co.

Principal records. Hall: "The cranium was received from Rev. Benjamin Hall, D.D., president of Geneva college, and was discovered

in a swamp on the farm of Gen. W. H. Adams of Clyde. The situation in which it was found is an elevated plateau or level tract of land, a portion only of which would be denominated a swamp, though the whole surface is covered with a peaty soil which supports a heavy growth of elm, hemlock and ash with some maple and beech . . . The precise locality of the fossil was near the termination of a shallow ravine or the bed of a small stream which flows into Lake Ontario in a northwesterly direction" ('47, p. 385–86).

BIBLIOGRAPHY

The following bibliography consists of the titles of the works referred to in the present paper, with the exception of those mentioned in the tables of synonymy only, where full references are always given.

Allen, Harrison. '64. Monograph of the bats of North America. (*see* Smithsonian miscellaneous collections. no. 165. June 1864)

—— '93. Monograph of the bats of North America. (*see* United States national museum. Bulletin 43. 1893)

Allen, J. A. '76. American bisons, living and extinct. (*see* Geological survey of Kentucky. 1876, v. 1, pt 2, p. 1–9, 1–246)

—— '77. Monographs of North American rodentia. (*see* United States geological survey of the territories 9th report. Aug. 1877)

—— '80. History of North American pinnipeds, a monograph of the walruses, sea-lions, sea-bears and seals of North America. (*see* United States geological and geographical survey of the territories. Miscellaneous publications. no. 12. 1880)

—— '94a. Notes on the mammals of New Brunswick, with description of a new species of Evotomys. (*see* American museum natural history. Bulletin 6. p. 99–106)

—— '94b. Remarks on a second collection of mammals from New Brunswick, and on the rediscovery of the genus Neotoma in New York state. (*see* American museum natural history. Bulletin. 22 Dec. 1894. 6 : 359–64)

American ornithologists' union. '89. Check-list of North American birds. Abridged ed. revised. 1889.

Audubon, J. J. & Bachman, J. '41. Description of new species of quadrupeds inhabiting North America. (*see* Academy natural sciences, Philadelphia. Proceedings. Oct. 1841. 1 : 92–103)

Audubon, J. J. & Bachman, J. '42. Descriptions of new species of quadrupeds inhabiting North America. (*see* Academy natural sciences, Philadelphia. Journal. ser. 1, v. 8, pt 2, p. 92–103. Reprint of '41)

—— '46, '51, '54. The viviparous quadrupeds of North America. v. 1, 1846, v. 2, 1851, v. 3, 1854.

Bachman, J. '37a. Observations on the different species of hares (genus Lepus) inhabiting the United States and Canada. (*see* Academy natural sciences, Philadelphia. Journal. 1837. v. 7, pt 2, p. 282–361)

—— '37b. Remarks on the genus Sorex with a monograph of the North American species. (*see* Academy natural sciences, Philadelphia. Journal. 1837. v. 7, pt 2, p. 362–402)

—— '37c. Additional note on the genus Lepus. (*see* Academy natural sciences, Philadelphia. Journal. 1837. v. 7, pt 2, p. 403)

—— '44. Observations on the genus Scalops with descriptions of the species found in North America. (*see* Boston society natural history. Proceedings. 1844. 1 : 40–41)

Bailey, Vernon. '96. Tamarack swamps as boreal islands. (*see* Science, *new series* 14 Feb. 1896. 3 : 250–51)

—— '97. Revision of the American voles of the genus Evotomys (*see* Biological society, Washington. Proceedings. 13 May 1897. 9 : 113–38)

—— '98a. Descriptions of 11 new species and subspecies of voles. (*see* Biological society, Washington. Proceedings. 30 Apr. 1898. 12 : 85–90)

—— '98b. New name for Microtus insularis Bailey. (*see* Science, *new series*. 2 Dec. 1898. 8 : 782–83)

Baird, S. F. '57. Mammals [of North America] (*see* Explorations and surveys to ascertain the most practicable and economical route for a railroad from the Mississippi river to the Pacific ocean. Report 8. 1857)

—— '65. Notice of a mole not enumerated by De Kay in the fauna of the state. (*see* 15th report of the regents of the University of the State of New York, on the condition of the state cabinet of natural history, and the historical and antiquarian collection annexed thereto. 1865. App. A, p. 1)

Bangs, Outram. '95. Geographical distribution of the eastern races of the cotton-tail (Lepus sylvaticus Bach.) with a description of a new subspecies, and notes on the distribution of the northern hare (Lepus americanus Erxl.) in the east. (Boston society natural history, Proceedings. 31 Jan. 1895 26: 404-14)

—— '96a. Review of the weasels of eastern North America. (Biological society, Washington. Proceedings. 25 Feb. 1896. 10: 1-24)

—— '96b. Notes on a small collection of mammals from Lake Edward, Quebec. (Biological society, Washington. Proceedings. 9 Mar. 1896. 10: 45-52)

—— '96c. Notes on the synonymy of the North American mink, with description of a new subspecies. (Boston society natural history. Proceedings. Mar. 1896. 7: 1-6)

—— '96d. Skunks of the genus Mephitis of eastern North America. (Biological society, Washington. Proceedings. 28 Dec. 1896. 10: 139-44)

—— '96e. Review of the squirrels of eastern North America. Biological society, Washington. Proceedings. 28 Dec. 1896. 10: 145-67)

—— '98. Eastern races of the American varying hare, with description of a new subspecies from Nova Scotia. (*see* Biological society, Washington. Proceedings. 24 Mar. 1898. 12: 77-82)

Batchelder, C. F. '96a. Some facts in regard to the distribution of certain mammals in New England and northern New York. (*see* Boston society natural history. Proceedings Oct. 1896. 28: 185-93)

—— '96b. An undescribed shrew of the genus Sorex. (*see* Biological society, Washington. Proceedings. 8 Dec. 1896. 10: 133-34)

Bragaw, D. F. '83. [Opossums at Woodside, Long Island]. (*see* Forest and stream. 11 Jan. 1883. 19: 467)

Britton, N. L. & associates. '88. Preliminary catalogue of Anthophyta and Pteridophyta reported as growing spontaneouly within 100 miles of New York city. 25 Apr. 1898.

Britton, N. L., & Brown, A. '96, '97 and '98. Illustrated flora of the northern United States, Canada and the British possessions from Newfoundland to the parallel of the southern boundary of Virginia and from the Atlantic ocean westward to the 102d meridian. v. 1, 1896. v. 2, 1897. v. 3, 1898.

Clarke, J. M. '88. Report on bones of Mastodon or Elephas, found in association with human relics in village of Attica, Wyoming co., N. Y. 1888.

Colvin, Verplanck. '80. Winter fauna of Mt Marcy. (*see* 7th annual report on the progress of the topographical survey of the Adirondacks, to the year 1879. Appendix. 1880. 364–74)

Cope, E. D. '65. Note on a species of whale occurring on the coasts of the United States. (*see* Academy natural sciences, Philadelphia. Proceedings. 1865. 17 : 168–69)

Coues, Elliott. '77. Monographs of North American rodentia. (*see* United States Geological survey of the territories. Report. v. 9. Aug. 1877)

Cuvier, F. '32. Essai de classification naturelle des vespertilions et description de plusieurs espèces de ce genre. (*see* Nouvelles annales du musée d'histoire naturelle (Paris). 1 : 1–21)

Dana, Jas. D. '95. Manual of geology. Ed. 4. 998–999.

Day, D. F. '82–'83. Plants of Buffalo and its vicinity. (*see* Buffalo society of natural sciences. Bulletin no. 3. April 1882. 4 : 65–152; no. 4. 1883. 4 : 153–290)

DeKay, J. E. '42. Natural history of New York. Zoology. pt 1, Mammalia. 1842.

Dutcher, B. H. '89. Bird notes from Little Gull island, Suffolk co., N. Y. (*see* Auk. April 1889. 6 : 124–31)

Emmons, Ebenezer. '40. Report on the quadrupeds of Massachusetts. (*see* Reports on the herbaceous plants and on the quadrupeds of Massachusetts. 1840. 1–86) (articles separately paged)

Falconer, H. '57. On the species of mastodon and elephant occurring in the fossil state in Great Britian. (*see* Geological society, London. quarterly journal. April 1857. 13 : 307–60)

Fischer, J. B. '29. Synopsis mammalium. 1829.

Fisher, A. K. '81. Some of the bats of Westchester co. N. Y. (*see* Forest and stream. 21 July 1881. 16 : 490)

—— '84. Seals in the Hudson off Sing Sing. (*see* Forest and stream. 10 Apr. 1884. 22 : 203)

—— '85a. Capture of an opossum in Essex co. N. Y. (*see* Forest and stream. 2 Apr. 1885. 24 : 184)

Fisher, A. K. '85b. Capture of the pine mouse at Sing Sing, N. Y. (*see* American naturalist. Sep. 1885. 19 : 896)

—— '96. Mammals of Sing Sing, N. Y. (*see* The Observer May 1896. 7 : 193–200)

Foster, J. W. '37. Miscellaneous observations made during a tour in May, 1835, to the falls of the Cuyahoga, near Lake Erie: extracted from the diary of a naturalist. (*see* American journal science and arts. Jan. 1837. 21 : 1–84)

—— '38. Report. (*see* 2d annual report on the geological survey of Ohio. 1838. 73–107)

Fraser, A. A. '89. Opossums on Long Island. (*see* Forest and stream. 4 Apr. 1889. 32 : 212)

Gueldenstaedt, A. I. '76. Chaus, animal feli affine descriptum. (*see* Novi commentarii academiae scientiarum Imperialis Petropolitanae. (1775) 1776. 20 : 483–500)

Hall, James. '47. Notice of the geological position of the cranium of the Castoroides ohioensis. (*see* Boston journal of natural history. 5: 385–91)

Hall, James. '71. Notes and observations on the Cohoes mastodon. (*see* 21st report of the regents of the University of the State of New York, on the condition of the state cabinet of natural history. App. F, 99–148)

Hill, Franklin C. '82. The opossum at Elmira, N. Y. (*see* American naturalist. May 1882. 16 : 403)

Hornaday, W. T. '89. Extermination of the American bison with a sketch of its discovery and life history. (*see* Annual report of the board of regents of the Smithsonian institution showing the operations, expenditures, and condition of the institution for the year ending June 30, 1887. 1889. pt 2, 373–548)

—— '98. Destruction of our birds and mammals. (*see* 2d annual report of the New York zoological society. 15 Mar. 1898. 77–126)

Howard, L. O. '95. Further notes on the San José scale. (*see* Insect life. March 1895. 7: 283–95)

Kerr, Robert. '92. The animal kingdom, or zoological system of the celebrated Carolus Linnaeus. v. 1, 1792.

Le Conte. '48. Notice of five new species of fossil mammalia from Illinois. (*see* American journal science and arts, ser. 2. 5 : 102–6)

Leidy, Joseph. '89. On Platygonus, an extinct genus allied to the peccaries. (*see* Wagner free institute of science of Philadelphia. Transactions. Dec. 1889. 2 : 41–50)

Lintner, J. A. '80. Lepidoptera of the Adirondack region. (*see* 7th annual report on the progress of the topographical survey of the Adirondack region of New York, to the year 1879. App. 1880. 375–400)

Loring, J. A. '99. Occurrence of the Virginia opossum in Southern Central New York. (*see* Science, new series. 13 Jan. 1899. 9 : 71)

[Lucas, F. W.] '82. [Porcupine and opossum near Rochester] (*see* Ward's natural science bulletin. no. 3. 1 Apr. 1882. 1 : 7)

Lydekker, R. '98. Deer of all lands; a history of the family Cervidae living and extinct. 1889.

Marsh, O. C. '92. Restoration of Mastodon americanus, Cuvier. (*see* American journal science and arts. ser. 3. Oct. 1892. 44 : 350)

Mearns, E. A. '98a. Study of the vetebrate fauna of the Hudson highlands, with observations on the mollusca, crustacea, lepidoptera, and the flora of the region. (*see* American museum natural history. Bulletin. 9 Sep. 1898. 10 : 303–52)

—— '98b. Notes on the mammals of the Catskill mountains, N. Y. with general remarks on the fauna and flora of the region. (*see* United States National museum. Proceedings. 4 Nov. 1898. 21 : 341–60)

Merriam, C. Hart. '81a. Tree-climbing woodchucks. (*see* Forest and stream. 7 July 1881. 16 : 453)

—— '81b. Beech nuts and woodpeckers. (*see* Forest and stream. 1 Dec. 1881. 17 : 347)

—— '82. Vertebrates of the Adirondack region, northern New York. (*see* Linnaean society, New York. Transactions. Oct. 1882. 1 : 9–106)

—— '83. Chipmunks and red squirrels. (*see* Forest and stream. 6 Sep. 1883. 21 : 103)

—— '84a. Seals in the upper St Lawrence. (*see* Forest and stream. 13 Mar. 1884. 22 : 124)

Merriam, C. Hart. '84b. The muskrat as a fish-eater (*see* Forest and stream. 27 Mar. 1884. 22:165)

—— '84c. Another seal in Lake Ontario. (*see* Forest and stream. 15 May 1884. 22:263)

—— '84d. Vertebrates of the Adirondack region, northern New York. (*see* Linnaean society, New York. Transactions. Aug. 1884. 2:9–214)

—— '84e. The 'hood' of the hooded seal, *Cystophora cristata.* (*see* Science. 5 Dec. 1884. 4:514–16)

—— '85. The pine mouse in northern New York. (*see* American naturalist. Sep. 1885. 19:895)

—— '86. Description of a new subspecies of the common eastern chipmunk. *see* American naturalist. Feb. 1886. 20:236–42)

—— '88. Do any Canadian bats migrate? Evidence in the affirmative. (*see* Royal society, Canada. Transactions. (1887) 1888. Sec. 5:85)

—— '90. General results of a biological survey of the San Francisco mountain region and desert of the Little Colorado, Arizona, with special reference to the distribution of species. (*see* North American fauna. no. 3. 11 Sep. 1890: 3–54)

—— '94. Laws of temperature control of the geographic distribution of terrestrial animals and plants. (*see* National geographic magazine. Dec. 1894. 6:229–38)

—— '95a. Geographic distribution of animals and plants in North America. (*see* Yearbook of the United States department of agriculture for 1894. 1895. 203–14)

—— '95b. Revision of the shrews of the American genera blarina and notiosorex. (*see* North American fauna. no. 10. 31 Dec. 1895. 5–34)

—— '95c. Synopsis of the American shrews of the genus sorex. (*see* North American fauna. no. 10. 31 Dec. 1895. 57–98)

—— '96. Synopsis of the weasels of North America. (*see* North American fauna. no. 11)

—— '98. Life zones and crop zones of the United States. (*see* United States department of agriculture, division of biological survey. Bulletin 10. Sep. 1898)

Miller, G. S., jr. '93a. A jumping mouse (Zapus insignis Miller) new to the United States. (*see* Biological society, Washington. Proceedings. 22 Apr. 1893. 8:1–8)

—— '93. Description of a new white-footed mouse from the eastern United States. (*see* Biological society, Washington. Proceedings. 20 June, 1893. 8:55–70)

—— '94. On a collection of small mammals from the New Hampshire mountains. (*see* Boston society natural history. Proceedings. 24 Mar. 1894. 26:177–97)

—— '95a. [Letter on the occurrence of the cottontail in central New York] (in Bangs '95) (*see* Boston society natural history. Proceedings. 31 Jan. 1895. 26:410)

—— '95b. Long-tailed shrews of the eastern United States. (*see* North American fauna. no. 10. 31 Dec. 1895. p. 35–56)

—— '97a. Migration of bats on Cape Cod, Massachusetts. (*see* Science, new series. 2 Apr. 1897. 5:541–43)

—— '97b. Notes on the mammals of Ontario. (*see* Boston society natural history. Proceedings. 30 Apr. 1897. 28:1–44)

—— '97c. Revision of the North American bats of the family Vespertilionidae. (*see* North American fauna. no. 13. 16 Oct. 1897)

—— '98. An instance of local temperature control of the distribution of mammals. (*see* Science, new series. 5 Nov. 1898. 8:615–18)

Morehouse, F. A. '83. [Opossum at Weedsport, N. Y.]. (*see* Forest and stream. 11 Jan. 1883. 19:467)

Müller, P. L. S. '76. Des Ritters Carl von Linné vollstandigen Natursystems Supplements und Register-Band. 1776.

Osborn, H. F. The Newburgh mastodon. (*see* *Science* 13 Oct. 1899. 10:539)

Palmer, T. S. '97. Extermination of noxious animals by bounties. (*see* Yearbook of the United States department of agriculture, 1896. 1897. 55–68)

Peck, C. H. '80. Plants of the summit of Mt Marcy. (*see* 7th annual report on the progress of the topographical survey of the Adirondack region of New York, to the year 1879. App. 1880. 402–12)

Pierce, James. '23. Memoir on the Catskill mountains with notices of their topography, scenery, mineralogy, zoology, economical resources, etc. (*see* American journal of science and arts (Silliman). 6:86–97)

Plumb, C. S. '98. Geographic distribution of cereals in North America. (*see* United States department of agriculture, division of biological survey. Bulletin 10)

Rafinesque, C. S. '17. Description of seven new genera of North American quadrupeds. (*see* American monthly magazine. Nov. 1817. 3:44–6)

—— '22. Annals of nature or annual synopsis of new genera and species of animals, plants, etc., discovered in North America.

Reed, J. H. '98. The terns of Great Gull Island, N. Y., during 1897. (*see* Auk. Jan. 1898. 15:40–3)

Rhoads, S. N. '94. Contribution to the history of the Alleghany cave rat, Neotoma magister Baird. (*see* Academy natural sciences, Philadelphia. Proceedings. Oct. 1894. 213–21)

—— '95a. Notes on the mammals of Monroe and Pike counties, Penn. (*see* Academy natural sciences, Philadelphia. (1894). Proceedings. Jan. 1895. 387–96)

—— '95b. Distribution of the American bison in Penn. with remarks on a new fossil species. (*see* Academy natural sciences, Philadelphia Proceedings. June 1895. 224–48)

—— '97a. Contribution to the mammalogy of northern New Jersey. (*see* Academy natural sciences, Philadelphia. Proceedings. Feb. 1897. 23–33)

—— '97b. Some notes on the mammals of Mammoth cave, Kentucky. (*see* Cincinnati society natural history. Journal. 24 Mar. 1897. 19:53–61)

—— '97c. Contribution to the mammalogy of central Pennsylvania. (*see* Academy natural sciences, Philadelphia. Proceedings. May 1897. 204–26)

—— '97d. Notes on a collection of small mammals from northeastern North Carolina. (*see* Academy natural sciences, Philadelphia. Proceedings. 303–12)

—— '98a. Owls, mice and moles. Question in economic zoology. (*see* Forest and stream 20 Aug. 1898. 51:143–44)

—— '98b. "Noxious" or "beneficial"? False premises in economic zoology. (*see* American naturalist. Aug. 1898. 32:570–81)

—— '98c. Contributions to a revision of the North American beavers, otters and fishers. (*see* American philosophical society, new series. Transactions. Oct. 1898. v. 19, pt 2, p. 418–39)

Scott, W. B. '85. Cervalces americanus, a fossil moose or elk, from the quaternary of New Jersey. (*see* Academy natural sciences, Philadelphia. Proceedings. 1885. 181–202)

Smith, A. M. '98. List of plants found on the Adirondack league club tract. (*see* Adirondack league club year book. 1898. 59–71)

Smith, H. M. '94. Flora of Honnedaga lake. (*see* Adirondack league club hand-book for 1894. 1894. 48–54)

Stone, Witmer. '93a. Description of a new Evotomys from southern New Jersey. (*see* American naturalist. Jan. 1893. 27: 54–56)

—— '93b. Description of a new species of Neotoma from Pennsylvania. (*see* Academy natural sciences, Philadelphia. Proceedings. (1893) 16–18)

Syracuse standard. '82. [Record of a seal shot in Onondaga lake in the suburbs of Syracuse] (*see* Syracuse standard. 29 Apr. 1882. Forest and stream. 11 May 1882. 18: 286)

Temminck, C. J. '35–'41. Sur les chiroptères vespertilionides formant les genres Nyctice, Vespertilion et Furie. (*see* Monographies de Mammalogie. 1835–41. 2:141–272. [Treizieme Monographie])

Thompson, E. S. '98. List of the big game of North America. (*see* Forest and stream. 8 Oct. 1898 51: 285–86)

Thompson, Zadock. '42. Natural history of Vermont. (*see* History of Vermont, natural, civil and statistical. pt. 1)

True, F. W. '89. Contribution to the natural history of the Cetaceans, a review of the family Delphinidae. (*see* National museum, new series. Bulletin. no. 36. 1889)

——'96. Revision of the American moles. (*see* National museum, new series. Proceedings. Dec. 1896. 19: 1–112)

Warren, J. C. '52. The Mastodon giganteus of North America. Boston 1852.

Wyman, J. '46 [On *Castoroides Ohioensis*]. (*see* Boston society natural history. Proceedings. 2: 138–39)

——'47. Anatomical description of the same [cranium of Castoroides ohioensis]. (*see* Boston journal of natural history. 1847. 5: 391–401)

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(*Pages 391–92 were bulletin cover pages*)

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FREDERICK J. H. MERRILL, *Director*

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PETROLEUM AND NATURAL GAS

IN

NEW YORK

BY
EDWARD ORTON, LL.D.

ALBANY

UNIVERSITY OF THE STATE OF NEW YORK

1899

CONTENTS

NOTE

The results here given are of investigations by Prof. Orton carried on during the season of 1897 at the instance of the late Prof. James Hall, state geologist and paleontologist, and were communicated with the annual report of that year; but it has since been judged wise, in view of the far-reaching importance of this paper and in order to secure its wider diffusion, to issue it separately as a museum bulletin. The paper is therefore appended to the museum report for 1899.

In references, volume and page numbers are separated by a colon; e. g. 16: 467 means vol. 16, p. 467.

JOHN M. CLARKE

EDWARD ORTON, LL. D. 1829-99

The distinguished author of this bulletin, Edward Orton, LL.D., died at his home, Columbus, Ohio, Oct. 16, 1899 after a brief illness. He had completed the reading of the proofs of this paper but a few days before this sad event.

Dr Orton was an eminent son of the state of New York and there is not a little appropriateness in the fact that this, the last of his scientific papers, is devoted to the interests of the state which saw his birth and the beginning of his scientific activities. He was born in the village of Deposit, Broome county in 1829, his father, Rev. S. G. Orton, being the minister of the presbyterian church in that place. In 1848 he graduated from Hamilton college and thereafter entered the Lane and Andover theological schools. Between these latter courses he studied at the Lawrence scientific school at Cambridge and here caught the inspiration of his future career.

In 1858 he became teacher of natural sciences in the state normal school at Albany and afterward served till 1865 as principal of the academy at Chester, Orange county. Hereafter his active interest and influence in education was transferred to the state of Ohio where he became successively president of Antioch college, president of the Ohio agricultural and mechanical college and first president of the Ohio state university. From the last named position he retired in 1881, retaining the chair of geology in that institution which he held till his death. In 1882 he was appointed state geologist of Ohio, having already served as assistant to the previous state geologist, Dr Newberry. He had been president of the Geological society of America and at the time of his death was president of the American association for the advancement of science.

Dr Orton was a man of many accomplishments and a wide diversity of interests. Though his life was one of great achievement and ended only after its full fruition, his loss is a grievous one to all students of American geology. Along the lines to which this bulletin specially pertains he had become the highest authority and most competent adviser.

PETROLEUM AND NATURAL GAS IN NEW YORK

CHAPTER 1

ORIGIN AND ACCUMULATION OF OIL AND GAS

The state of New York is comparatively poor in the two great forms of stored power; namely, coal and petroleum. Its metes and bounds were fixed long before the real value of coal could be properly appreciated, and also long before its place in the geologic scale had been determined, while as for petroleum and its most important derivative, natural gas, both of them continued to be regarded as nuisances to be abated rather than as a possible source of wealth, till about the middle of the present century.

Within the established boundaries of this state a few square miles of the rocks of the Carboniferous age are included in Chautauqua and Cattaraugus counties. These Carboniferous rocks are found as outliers on the high hills at the head of the present drainage systems and are obviously "remnants that remain" from and represent a great sheet that originally included all the outliers that we know and extended beyond them in all directions. These outliers are all fragments of the great conglomerate, and none of them contain coal seams of economic value.

Section 1

Geologic structure, as connected with the accumulation of oil and gas

As for the accumulation of oil and gas we have learned that they follow the great structural features of the strata in which they are contained, which were established in them largely at the time of the Appalachian revolution. No more important generalization has been established in this great section of economic geology and none more abundantly supported than this; namely, that oil, gas and water, the usual contents of buried porous strata, have been separated from one another under the influence of gravity and have been accumulated at different levels, in the order of their specific gravities, by the same force.

All the facts bearing on these points seem intelligible and rational. They are in accord with the teachings of physics and thus are what we should naturally expect to find in this field.

The principal structural features to which allusion has been made, are commonly known as anticlines, synclines and monoclines. The first of these terms is applied to a roof-shaped arrangement of the strata of a district, in which they decline in opposite directions from a given line called the axis. Sometimes the descent on the opposite sides is equal in amount, but more frequently it is unequal. The axis can generally be followed for a few miles in an approximately straight line, but in many cases its elevation is gradually lost. From the point where it thus disappears, it is quite likely to rise again in the same general direction and at perhaps the same elevation that it originally had. Of course, in such cases, all the fragments are counted as a single axis. Wherever a well-defined axis is found, one or more similar lines of structure are very likely to occur, approximately parallel to the first.

A syncline is a form of arrangement of the strata exactly opposite to the anticline already described. The strata are bent into a trough, instead of into a ridge. All the statements as to the amount and direction of the descent of the different sides that have just been made as to anticlines are to be applied to synclines, with the proper, i. e. reversed, qualifications. In a word, a syncline is the normal complement of an anticline, and when two parallel anticlines occur, the space intervening between them is necessarily occupied by a syncline.

A monocline is in effect an incomplete anticline or syncline. A stratum descending from an approximately horizontal position at a certain level to a lower level regains the original horizontal position after making the descent. It is as if nature began to build an anticline or syncline and was not able to finish it. Monoclines are of much less frequent occurrence than anticlines and synclines.

All these forms of structure are necessarily effected in the differentiation of the contents of a porous stratum. The water, which has been named as one of the three principal elements

contained in such strata, is in most instances saline. With respect to water found at a depth of 500 feet or more, the presumption in many parts of the world is that it is saline. Compounds of soda and potash are widely diffused in the crust and many of them are very soluble and are gathered, accordingly, in underground water. Where the arrangement of the rocks is such that outflow occurs, the soluble compounds will, in the course of time, have all been carried out, and the outflowing water may at last have a high degree of purity. But, in multitudes of instances, the porous strata are so folded that the water of large portions has no access to the surface. When the drill reaches such areas, concentrated brines are often found. Saline water is always heavier than fresh water. It is not uncommon to find these deep waters increased in gravity by one tenth beyond the proportions of pure water. It goes without saying, therefore, that the synclines of the porous rocks, would be occupied by these heavy waters, and it is equally obvious that all the oil will rise to the sides and summits of the arches unless gas accompanies the oil, in which case, the highest level will necessarily be occupied by the latter.

The great development of anticlines and synclines is to be found in mountain regions, and here they are shown in their most striking forms. Parts of the great Appalachian system afford the most complete exhibition of these types of structure that is known in the world, though the Jura mountains of western Europe also furnish admirable examples of folded rock series. It is not in mountain regions, however, where he that runs can read the arches, the elements that constitute them, their dips and their directions, that accumulations of petroleum are to be looked for. When the rocks are folded into great arches that constitute the principal scenic features of the regions which they occupy, they have not escaped fracture at their summits. Faulting has also taken place in numerous instances along their axes, and by these two agencies, namely, fractures and faults, great accumulations of oil and gas have been made impossible. Such fractures give rise to a slow escape of oil, gas or mineral water, the latter often being characterized by temperatures above the nor-

mal. These prolonged escapes of gas and oil constitute most of the so-called " surface indications " of petroleum.

The system of arches and folds above named, that find their chief development in mountain regions, and to which, in fact, the mountains mainly owe their origin, are the results of the contraction of the crust of the earth, apparently due to its cooling. In the Appalachian region of Pennsylvania, Claypole has calculated that the shortening in of the original crust has amounted to 88 miles out of 153 miles, the latter having been reduced to 65 miles. Heim has calculated that an original extent of 203 miles in the Alps has been reduced by folding and crumpling to 130 miles. The arches seem to have resulted from lateral pressure exerted from the side of the ocean. Their axes are approximately parallel to the ocean boundary. Their slopes are gentle on the southeast side and much sharper on the northwest. The strongest folds, as a rule, lie farthest to the eastward. Certainly they diminish in both hight and dip as they are followed westward. In western Pennsylvania, for example, the folds are so reduced that they do not necessarily form the uplands of the region. They can be followed only by determining the elevation of some well-marked bed or stratum, as a seam of coal or sheet of limestone, or some persistent bed of red or blue rock, the peculiarities or the composition of which are well known. By such facts, the reality of the arch is demonstrated and their directions and angles of pitch can be determined.

All the valuable accumulations of petroleum and its derivative, natural gas, in Pennsylvania, are confined to these flattened and dying arches, the slopes of which seldom exceed two or three degrees, and which generally need to be read in minutes instead of degrees. No accumulations are known where the arches show angles of descent of five or 10 degrees or more. It would seem that the strata were cracked in the bending, thus allowing the escape of all mobile substances inclosed in the porous rocks of the series.

Following the effects of the Appalachian revolution still farther westward, we come to the still feebler arches and monoclines of Ohio. Numerous cases have been found during the last few years in which the elevations of even the summits of the

arches have not been found sufficient to effect a separation of the petroliferous substances and the salt water. In the "Big Indian" oil field of Monroe county, Ohio, many cases have occurred in which three or four barrels of salt water are raised by the pumps for every barrel of oil. The latter is, however, frequently produced in amounts of hundreds of barrels in a day.

The best defined monocline known is the Macksburg oil field of Noble and Washington counties, Ohio. In this case it has been demonstrated that the Berea grit has been checked in its uniform descent to the southeastward, at the rate of 20′ or 30′ of a degree and that it lies nearly horizontal for the space of one mile. This horizontal portion has proved available as a storehouse of oil and gas, and a petroliferous production of considerable importance is distinctly referred to this structure, with gas on its western boundary and salt water on the east. We owe the determination of this monocline and the general facts of its productive power, to F. E. Minshall, of Marietta.

Coming back to New York, we find that it was invaded by the Appalachian revolution with its mountain-making forces in very much the same way that western Pennsylvania and eastern Ohio were affected. Through the southern counties of the state, low arches are produced, which lack the force necessary to make them recognizable as features of the present surface relief, but which, as exploration has proved, were ample for the separation of the oil and salt water that were tributary to its porous strata. All the extensions of the great Bradford oil fields into Cattaraugus and Allegany counties are examples. Of these the "Rixburg gas streak" is one of the best.

But while the eastern side of the continent owes to the Appalachian revolution the great features of its relief, it has not been limited to the orogenic activities of this period. Contraction and necessary readjustments of the crust were certainly in operation long before the close of paleozoic time, and the earliest formed strata were left in an uneven condition. The steady growth of the continent from the Canadian protaxis southward is responsible for structural facts of great importance, specially for the prevailing southerly dip that affects the entire state and that

contributes so much to the completeness of the geologic column of New York.

In these previous movements of the crust, more or less relief was given to the land surface or sea floors of the times in which they occurred, and many low arches and synclines resulted in this way; but no prevailing direction is thus far found in any of these ancient structures, aside from this southerly dip already named.

It is not counted necessary in a paper designed specially for the general reader, to furnish proof of the statements already made as to the order of arrangement of the several substances contained in porous rocks. It is enough to say that the facts from every oil field fall into line in support of these statements. Moreover they harmonize so well with the teachings of physics that they soon come to be counted necessary truths and no grounds are apparent from which attacks can be directed against them. Even the disposition to make such attacks seems to have passed away.

The Trenton limestone field or northwestern Ohio, one of the latest oil and gas fields to be exploited, furnishes the most satisfactory and conclusive proofs on all these points. Five or six feet of relief have proved ample to keep gas wells dry for days and weeks, and wells drilled solely for gas and operated as such, have been slowly turned into highly productive oil wells, and, in multitudes of cases, have, at a later date, been overrun with salt water.

Section 2

Origin of petroleum, natural gas, maltha and asphalt

The readers of this paper will expect some attempt to answer the questions that human curiosity everywhere raises as to the origin of the bituminous series. The series has long been known to man. We find mention of it in the oldest records and traditions of the race, but its real value and importance have been mainly developed in the present century and very largely in our own day.

The bituminous series contains at least four well-marked elements; namely, natural gas, petroleum, maltha or mineral tar,

asphalt. The probable order of their derivation is not the order given above. From petroleum as an original center the other three substances are seen to be easily derivable by natural and familiar processes. From deep-stored oil when brought to day natural gas is always given off. By the removal of the gaseous hydrocarbons, the gravity of the petroleum is increased and the process of oxidation sets in, the effect of which is to darken the oil and still further reduce its gravity. We advance but a little way along this line before we begin to withdraw the name of petroleum from the dark and viscous liquid that we find resulting and give the substance the more appropriate designation of mineral tar. It is also called maltha, which is an ancient and somewhat technical designation.

Now, if the mineral tar is still further exposed and oxidized, it loses its liquidity altogether and hardens into a black solid, dull or shining, as the case may be, called asphalt.

Further, the petroleum from which the latter products are derived has itself a wide range in gravity. Some examples of it run as light as 55° B. while in other cases heavy oils of less than 20° B. occur. In the latter case it is always possible to explain the facts by the loss of the volatile elements as they approach the surface. All shallow oils, under which designation are included the occurrences of petroleum within one or two hundred feet of the surface, are heavy. Some of them are too viscous to flow freely and are well adapted in the natural state to lubricating purposes.

Not only does the fact that gas, maltha and asphalt are easily derived from petroleum point to the latter as the original substance, but the facts as to the chemical composition of oil and gas respectively lead to the same conclusion. Natural gas consists essentially of light carburetted hydrogen (CH_2), while petroleum has a much more complex composition. The simplicity of the former points to it as the derived substance. It is therefore necessary to account for the origin of petroleum only. All its derivatives will be explained under the same head.

The subject has proved a tempting one for consideration and as the economic importance of the series has increased it has commanded more and more attention, till there is at the present day a voluminous literature devoted to it. In regard to the

question, from what source and by what process did petroleum originate, we find many and discordant answers. A distinguished German geologist, Prof. C. F. Zincken, of Leipzig, says that for this subject we can well adopt the inscription placed over a meteorite that fell, centuries ago in Germany. *Multi multa; omnes aliquid; nemo satis.* These words can be thus translated: "Many men say many things; everyone says something; nobody gives a satisfactory account." When we come to analyze the various answers as to the origin of petroleum the case is not as discouraging as this statement would lead us to conclude. There is one point of vital importance in the discussion, and in regard to this it may now be said that there is substantially an agreement among all geologists who have earned the right to speak on the question; and, what is equally to be desired, there is a rapidly growing accord among chemists who are prepared to apply first-hand knowledge to the discussion of the subject. The vital point above referred to is the question whether petroleum is the product of chemical affinity, exerted on inorganic matter, or whether it is a result of the transformation of substances that have been built up under the agency of life. It is the latter line of answers that has come to be universally accepted by geologists and it now looks as if there would soon be equal unanimity among chemists in regard to the same point.

Section 3

Theories of origin

a *Theory of inorganic origin*

It has been claimed by a number of chemists, some of whom hold high rank in the scientific world, that the several members of the bituminous series can be referred to a purely mineral origin. There are several phases of this doctrine. One of them seems to imply that the elements, carbon and hydrogen, are combined in the interior of the earth through the agency of the high temperatures prevailing there. This phase of the doctrine matches to but few facts in nature and does not appear to be making progress.

The most widely accepted theories as to the inorganic origin of petroleum are those that refer it to certain definite chemical

reactions. Two among these theories have obtained a wide circulation by reason of the high rank of their authors, but they can not be said to have gained an equally wide acceptance.

In 1866 Berthelot, professor of chemistry in the college of France, and distinguished by remarkable and epoch-making discoveries in organic chemistry, particularly as to the composition of alcohols and sugars and by the discovery of acetylene, advanced the theory that the interior of the earth contains free alkali metals (sodium and potassium) and that these elements, when acted on by carbonic acid or carbonates at a high temperature would form carbids of these metals, which, by the action of water, would form hydrocarbons analagous to those found in petroleum. In short, he proposed the theory that both liquids and gaseous hydrocarbons of the bituminous series would result if meteoric water carrying carbonic acid or earthy carbonates in solution should reach by infiltration the metallic masses above named at a white heat and under high pressure. The chemical reactions invoked under the conditions named are undoubtedly sound, and the bituminous series would unquestionably result if these conditions should be met. The recent production of calcium carbid by the electric furnace on a commercial scale and its common use in the production of acetylene gas as an illuminant have made the process familiar and have given to it an air of reality that it never before possessed.

The theory of Mendeljeff, the eminent Russian chemist, is founded on altogether similar lines, but is relieved from some of the glaring improbabilities of Berthelot's hypothesis. It was first announced in 1877 and has been revamped and restated by the author during the present decade. Mendeljeff is the author of one of the most remarkable generalizations ever made in the science of chemistry. It is known as the *periodic law,* and has given to the science the ability of predicting future discoveries, similar to that so long possessed by astronomy, and which is recognized by all as the crowning proof that a science has reached its perfect, though not necessarily, its completed stage. There is no higher name in chemistry today than that of Mendeljeff.

His theory in regard to petroleum formation is briefly this. He supposes the interior of the earth to contain large masses of

metallic iron and counts the formation of meteorites confirmatory of this conclusion. He also considers the specific gravity of the earth, which is 5.5 against 2.5 for its surface rocks as rendering it certain that the interior contains substances heavier than ordinary rocks. In these interior masses of metallic iron he supposes more or less carbid of iron to exist as in meteorites. Carbids of iron would also be formed by the descent of carbonated water as in Berthelot's theory. Water infiltrating through fissures in the crust would be turned into steam at the depth supposed, and attacking the carbid of iron, would give rise to the petroleum compounds. The steam already invoked exerts pressure enough to force the petroleum vapors back toward the surface till they would become condensed by cooling and would be stored in all porous rocks capable of containing them. This is by far the most widely known and powerfully supported theory of the inorganic origin of bitumens. Mendeljeff expresses himself as satisfied with it and declares that petroleum is as truly a product of chemical affinity as a veinstone or an ore. This theory seems to promise a continual production and thus an unfailing supply of oil and gas and is sure to be welcomed in every field that is entering on its exploitation.

In like manner chemists who have given but little attention to the geologic facts connected with oil and gas further than that they occur beneath the surface, finding a theory at hand explaining the origin of these interesting substances on sound chemical possibilities, have naturally turned to this explanation with prejudice in its favor. Occasionally, also, a geologist has been misled by it, but, little by little, as the far-fetched and highly improbable assumptions of this theory have come to be considered and as a far simpler and more probable account of the origin of bitumens is at hand, Mendeljeff's speculations have lost standing with men of a practical turn, both chemists and geologists, till of late years no one has been found to champion it as if he believed it. To geologists, indeed, it sounds like an echo from the 18th century. It takes its place with the "cloud-capped towers and gorgeous palaces" of the speculations of Werner's time, 100 years ago.

The latest vigorous defense of the theory in question was made in 1889 by Mr William Anderson, at that time president of the

mechanical section of the British association for the advancement of science, but this defense revealed such profound and surprising ignorance and misconception of the geologic facts as to the occurrence of petroleum that it necessarily lost weight with all who are familiar with these facts, and must have weakened rather than strengthened the theory itself. [For an examination of this defense see *Geology of Ohio, Annual report*, 1890, p. 61.] A weighty consideration in this connection is found in the geologic distribution of petroleum and its derivatives.

We can roughly divide the rocks of the earth's crust into two great series, namely, those in which organic remains are more or less abundant, and those in which no traces of life are found. Their absence in the latter case may be accounted for either because life had not been introduced at the time of their formation, or by reason of metamorphic changes that have supervened since their origin, by which all such traces, if ever present, have been removed. In the last named division, neither petroleum nor any of its derivatives is ever found, and all its occurrences are confined to the fossiliferous division. While Archaean rocks do not cover as large an area as the vast series formed in the ages of life, they are by no means insignificant in extent. 2,000,000 square miles in one continuous body are referred to this division in the Canadian protaxis alone, and in the other continental masses a like distribution is recognized.

A single exception as to the absence of the entire petroliferous series from the Archaean rocks must, however, be made. In a few localities in the uppermost division of this series in Ontario, considerable deposits of an asphalt-like material, thoroughly compressed and hardened, are found. It can be made to burn only under the most favorable conditions. That the substance originated in petroleum is highly probable, but it is to be borne in mind that the rocks in which it is contained bear unmistakable evidences of having been originally stratified. If stratified they may have contained the remains of life. But aside from this and probably a few other exceptional cases, petroleum and all the substances derived from it are wholly wanting in the Archaean rocks. There is not an oil field in the world in the rocks of this age.

This fact alone constitutes a weighty argument against the hypotheses already presented. If the real centers at which petroleum originated are to be found in the primeval crust, according to Berthelot and Mendeljeff, the carbonated water essential to the process would certainly have a shorter course in reaching these masses of uncombined elements or metallic carbids by descending through the uncovered Archaean than by going down through thousands of feet of the stratified and fossiliferous rocks that overlie this formation.

Another fact that bears against the theory named above is the steady and notable increase in bituminous products that has seemed to go forward throughout geologic history. Their maximum production was apparently reached in Tertiary time. But the internal heat of the earth, which is an important factor in the theories named has been gradually reduced during these same ages. The results are thus directly contradictory to those required by Berthelot's and Mendeljeff's assumptions.

We come, therefore, to another line of explanations.

b *Origin from organic sources*

The reference of petroleum to an organic source stands in very different relation to familiar facts from the theories already reviewed. Petroleum is a combustible substance and every other substance that we know in nature that can be burned is of organic origin. Moreover we can produce artificially from vegetable and animal substances gaseous and liquid compounds that are closely allied to the bituminous series or even identical with them. The manufacture of illuminating gas furnishes a case in point. We obtain by this process not only the volatile combustible, but the liquid coal tar as well, that is closely analogous to some of the petroleum compounds. Illuminating gas is ordinarily manufactured from bituminous coal, but we can use all varieties of vegetable and animal substances for the same purpose. Even street sweepings and the ordinary refuse of a city have been by a patented process applied to the same manufacture. The occurrence of gas at the bottoms of ponds, produced from decaying leaves, or in boulder clay, from buried vegetation, are phenomena of common note.

In addition to these facts it has been definitely established within the last 30 years that the genuine and unmistakable members of the petroleum group, including illuminating oil, lubricating oil, benzin and paraffin, can be obtained from the distillation of fish oil. The demonstration was first made by two American chemists, Messrs Warren and Storer, in 1867-68. 20 years afterward, Dr Carl Engler, of Carlsruhe, Germany, duplicated and extended their experiments. Based on these striking results, several chemists have lately advanced the claim that petroleum is altogether restricted to this particular origin, namely, to the fatty oils of fishes.

That this claim is altogether untenable may be seen, among other considerations, in the fact that the Trenton limestone oil field of Ohio and Indiana, at present the most important in the United States, antedates by vast periods of time the introduction of fishes into the geologic scale of the country at large.

Further, during the last year (1897) Dr S. P. Sadtler of Philadelphia, read a paper before the American philosophical society in which he announced the very interesting and important result of having obtained hydrocarbon oils of the true petroleum type by the distillation of the glycerids of oils derived from vegetable seeds, thus duplicating Dr Engler's results and confirming the charge of overhaste on the part of those who ascribe the origin of petroleum generally to products of the vertebrate subkingdom.

To the general statement, therefore, that the bituminous series, petroleum, gas, asphalt, etc. are all derived from organic sources, it can be safely said that at the present time all geologists subscribe. Prof. C. F. Zincken of Leipzig has recently said "Not a doubt any longer prevails as to the derivation of petroleum from organic matter." It appears also that chemists are generally coming to the same conclusion despite the brilliant but fanciful and unverifiable theories of Berthelot and Mendeljeff. It is entirely unnecessary to descend to the region of igneous fluidity to find the genesis of these invaluable substances because there is always an organic source nearer at hand. The law of "parsimony of force" is applicable to the case.

But though geologists are agreed as to the organic source of the petroleum series, when we inquire as to the probable mode

of their origin we find at once well marked differences of opinion and belief. One school declares that petroleum is the result of the *primary decomposition* of organic matter contained in the rocks under certain favoring conditions, while another and larger section holds that it is always the result of the *secondary decomposition* of organic matter, or, in other words, that it is due to a process of *destructive distillation.*

1 *Origin by primary decomposition.* Of the first view the late Dr T. S. Hunt is the chief exponent and defender. According to this theory the decomposition of organic matter was mainly effected *in situ*; that is, in the strata in which the materials were stored, and the resulting product is therefore mainly indigenous to the strata in which it is found. This last feature is seized on in many popular statements and a theory of indigenous origin is made to include the various forms of theories of this class.

Dr Hunt held that there was an accumulation of organic matter in oil-bearing rocks that passed by a peculiar form of decomposition or decay directly into petroleum; in other words, these substances, instead of passing into the usual products of decay, namely, carbonic acid, ammonia, water, etc. were transformed directly into the bituminous series. This author also strenuously urged that as limestones are essentially of organic origin it is to this form of rocks that we must look for the chief source of the production of petroleum. He insisted on this view a score of years before a barrel of oil was ever drawn from the limestone beds of the country. In the light of the remarkable stocks of oil and gas that have been derived from the Trenton limestone within the last dozen years, Dr Hunt's claims show great prescience and sagacity. He appears to very much better advantage in connection with this revolutionary discovery than any other geologist of his generation.

But *does* organic matter pass by primary or direct decomposition into petroleum? Have we any examples of this process in operation in the world today? This is a fair and would seem to be a crucial question. If it is an actual process in the world it ought somewhere to be found in operation.

Dr Hunt seemed to see this question in its true significance and lays a great deal of emphasis on the testimony of Messrs

Wall and Kruger as to the asphalt lake of the island of Trinidad. [*Proceedings*, Geological society of London, 1860]

These gentlemen declare that the organic matter contained in the shaly rocks in which the lake is included has undergone a special mineralization, producing bitumen in place of ordinary anthraciferous substances. "This operation is not attributable to heat nor to the nature of distillation, but is due to chemical reactions at the ordinary temperature and under the normal conditions of the climate. The proofs that this is the true mode of the generation of the asphalt, repose not only on the partial manner in which it is distributed in the strata, but also on numerous specimens of the organic bodies in the process of transformation and with the organic substance more or less obliterated. After the removal by solution of the bituminous material under the microscope a remarkable alteration and corrosion of the vegetable cells becomes apparent which is not presented in any other form of the mineralization of wood." [*Quarterly journal* Geological society of London, 16: 467]. If these claims were substantiated the question would seem to be settled, but unfortunately for them several later observers only fail to confirm them, but report distinctly different conditions.

A few years since the late Dr O. Fraas of Stuttgart, Germany, announced that petroleum is in process of formation in certain coral rocks of the Red sea, as the result of the direct transformation of the organic matter of the reef. If this statement could be proved it would also meet the demands of Hunt's theory; but geologists recognize the fact that there are other possible sources of the petroleum that appears in the reef, and Fraas's claims can not be counted as established till all such possibilities are excluded. There are other similar cases, but none of them are decisive.

On the whole it must be acknowledged that the crucial experiment remains to be brought forward that will establish the claim that petroleum is now in process of formation by the direct or primary decomposition of organic matter. There are multitudes of geologic facts that seem to be in harmony with this view, and it has never been definitely set aside or abandoned, but to

meet the demands of science we ought to find somewhere positive proof of its reality as a living force or process in nature.

2 *Origin by secondary decomposition or distillation.* That organic matter stored in the rocks can be converted by heat into the petroliferous series is amply demonstrated by the practical operation of the process referred to as the manufacture of illuminating gas and paraffin from coal, bituminous shale and organic waste. In the primary decomposition or decay of organic bodies no extraordinary force is needed to produce the result. The instability of the chemical elements involved is adequate. Through the agency of life these elements were temporarily combined into the complex atoms which constitute organic bodies, but as soon as the principle of life is withdrawn the elements tend to resume the simpler combinations out of which organic bodies were constructed.

In what is called the secondary decomposition of organic bodies the agency of unusual heat is called in. Just what the lowest temperature is at which this process goes forward has not been determined but probably no one would claim that it comes into operation below 400° F. and the usual temperature of the artificial process that we employ is probably twice this or such as is represented by a low red heat. This secondary decomposition is also called *dry* or *destructive distillation.* From the organic substances to be acted on, the atmosphere is excluded, and, by the application of heat, as above indicated, the atoms of the body are rearranged in the shape of hydrocarbon compounds, gaseous and liquid, and there is also left over from this process a carbon residue or coke. These two facts, a temperature of not less than 400° F. and a carbon residue are indispensable accompaniments or conditions of what we call dry or destructive distillation.

That this process or rather some modification of it which retains all its conditions is effective in nature there seems no reason to doubt. When molten rock is forced upward through a series of strata, some of which, as for example, carbonaceous shales, are loaded with the remains of animal or vegetable organisms, the conditions of a gas retort are practically reproduced. The exclusion of the atmosphere, the high temperature, the organic matter, the pressure, are all here, and we can not wonder at the appearance of hydrocarbon compounds essentially like the

products of the gas retort. The production of gas and petroleum in connection with volcanic agencies is of frequent occurrence and does not excite our wonder. It is easily explained in accordance with the principles above noted. In such cases the strata that are traversed by molten rock show the effect of the unusual heat to which they have been subjected by unmistakable transformations.

There seems therefore no reason to doubt that destructive distillation gives origin to some occurrences of the substances whose origin we are considering. But there are several strenuously urged and widely accepted theories that put this agency in the front rank and in reality make it the great source of petroleum. Two of these theories may be named in this connection: those, namely, of the late Dr J. S. Newberry and of Prof. S. F. Peckham.

Newberry's theory was the first to be fully and elaborately stated and was propounded at the right time, viz, just when petroleum was coming to its first full recognition. It seemed to match well with many familiar facts of observation and was accordingly received with something like enthusiasm, as giving an intelligible and rational answer to questions that everyone was asking.

It was first published in a paper on the rock oils of Ohio in the *Ohio agricultural report for* 1859. He says: "The precise process by which petroleum is evolved from carbonaceous matter contained in the rocks which furnish it is not yet fully known, because we can not in ordinary circumstances inspect it. We may fairly infer, however, that it is a distillation, but generally performed at a low temperature." Again he says: "The origin of these two hydrocarbons (petroleum and gas) is the same, and they are evolved simultaneously by the spontaneous distillation of carbonaceous rocks." [*Geology of Ohio*, 1: 192]

In Dr Newberry's view the great black shale of Ohio (Hamilton, Portage, Chemung) is the main source of the petroleum of the oil fields of western Pennsylvania, New York and eastern Ohio, which these shales underlie.

Prof. S. F. Peckham has furnished another statement of the distillation theory but has recognized the necessity of higher than normal temperature and has added a source of heat to

account for at least the Pennsylvania petroleum. This source of heat he finds in the rise of temperature attending metamorphism and developed by the elevation of the Appalachian mountain system. He says: "Bitumens are not products of the high temperatures and violent action of volcanos, but of the slow and gentle changes at low temperatures, due to metamorphic action on strata buried at immense depths."

Both of these theories are open to the objection that they use the term distillation in a different sense from that which it regularly holds. It is a technical word and has a definite meaning, but this meaning is ignored by both of the authors named. Newberry speaks of "low temperatures", evidently implying conditions either normal, or not far from normal and as still in progress. Peckham declares that "it is not likely that the usual form of destructive distillation as illustrated in a gas retort has obtained anywhere in the operations of nature." [*Proceedings*, American philosophical society, 1898]

To speak of distillation as going forward without a coke residue and at low or ordinary temperatures is pure assumption. For such a process we find no warrant in science. It is a matter of inference pure and simple. We find certain rocks with oil and gas which closely resemble the products of the dry distillation of organic bodies and we infer that the latter are due to a process that we choose to call by the same name, and we talk vaguely of time being exchanged for temperature as if the maintenance of a temperature of 100° for thousands of years could be made to do the work of a temperature of 1000° for a shorter time. All this may be true but there is no scientific demonstration of it. This distillation theory stands on very much the same basis as Hunt's theory of the primary decomposition of organic matter into the petroliferous series. The supposed facts adduced in support of it do not appear to stand examination.

The great difference between these two classes of theories seems to be that they assign very different dates for the origin of the petroleum found in the rocks. Hunt's view would refer it to the date of the formation of the rocks, the organic matter of which would be at once transformed into the permanent shape which we find in petroleum.

The distillation theory allows that the organic matter of the rocks passed for the time being through the anthraciferous state, in which it could remain indefinitely. Peckham's original theory referred the oil of Pennsylvania to the close of the Appalachian revolution, but his later statements seem to imply that he no longer considers this date of special importance. Newberry held that the process of petroleum production was in constant operation, but he recognized that the world is old and that vast periods of time have been open to the action of this process.

What geologists would be glad to find in nature as matching to and harmonizing with the facts with which they are obliged to reckon would be a process in which the products of the organic world are transformed into mineral oil at ordinary temperatures and with complete consumption of the substances acted on, so that no carbon residue would be left behind. They would also expect the transformation to be accomplished while the organic matter still retained essentially its original character.

The point of greatest importance is the ultimate source of the bituminous series. In regard to this, as already implied, both geologists and chemists are coming into full accord. Both find in the organic matters which the rocks contain or have contained in their past history a source at once abundant, everywhere at hand and competent to meet every demand. The oily substances escaping from the waste in gas manufacture naturally float on the surface of the water into which such waste may be conducted, but the fine particles of clay in the water unite with the oil and settle with it to the bottom. This represents a very important fact in nature and meets the objections that Mendeljeff and others have urged to the effect that petroleum, unless confined in the rocks, would rise to the surface of the sea and be at once wasted by exposure to the atmosphere. On the contrary we see that clay, the second substance in abundance in the crust of the earth, absorbs and protects the petroleum.

To this statement we can add another, namely, petroleum seems to be, when thus protected from the air, one of the durable forms that organic matter can assume. There seems no reason to believe that it is less permanent than coal. Stored in the rocks in the morning of the world it can apparently remain in this condition through the vast and indefinite ages of geology.

One qualification, perhaps, needs to be added; namely, that petroleum as stored in the rocks may be transformed there into the inflammable gas that belongs in the same chemical series and which may be even more stable than the oil, by as much as it is simpler in composition. It may even be that the oil would be entirely converted into gas in the process of the ages.

It seems altogether probable that the oil and gas which we find in the rocks are of widely different ages, corresponding to the ages of the formations in which they are stored. Thus we may have Cambrian, Ordovician, Silurian, Devonian, Carboniferous, Triassic, Jurassic, Cretaceous and Tertiary petroleums.

The facts of geology seem to show that it is exceedingly improbable that gas or oil have been transferred in a large way from one formation to another in the geologic column. This statement requires qualification. That there has been some transfer of petroleum and gas in the rocks is beyond question. They are associated with water and gravitation will always raise them to the highest point in the stratum in which they happen to be. If the reservoir was fractured at the summit of an arch these mobile substances will follow the lines of escape to the surface, if the latter extend thus far, and must certainly diffuse themselves through any porous beds which the fracture crosses.

With such escapes of oil and gas we are familiar. We call them "surface indications" and they often lead us directly to the storehouse from which they have issued.

In like manner a porous rock is often found stored with petroliferous products evidently derived from a stratum or bed directly underlying it. The most common form of such occurrence is a sandstone overlying a carbonaceous shale. When such a series rises to the surface the porous rock is often charged with maltha, resulting from the oxidation of the original petroleum. If the sandstone is in demand for building purposes, the tar is often found exuding from it, even for years. Tar springs, so called, have a like origin, the escaping water of the porous rock carrying out some of the inspissated petroleum.

CHAPTER 2

GEOLOGIC SCALE OF NEW YORK, AND ITS RELATION TO OIL AND GAS

The geologic scale of New York is more symmetric and complete than that of any other state of the Union. A greater number of changes in the conditions of the sea in which the successive deposits that compose the great part of the state were laid down is registered than is to be found elsewhere and many of these deposits obtained here their full development as far as both lithologic elements and fossil contents are concerned. We go to New York for the typical representation of most of the elements of the geologic scale of North America. In other words, the New York column is the typical column. When it is added that the systematic study of the geology of this country was begun by the state geological survey of New York and that the geographic names drawn from localities in that state are fixed on all the leading formations, and farther when it is remembered that the state survey has expended a large amount of money, in the description and representation of the fossils of its several divisions, it is easy to see that the geology of New York must, on all accounts, be regarded as the standard of the eastern side of the continent.

In the northern prolongation of the state known as the Adirondack highlands a considerable area of Archaean rocks is exposed. This area is now being studied, subdivided and mapped, and much light is being thrown on it by the work now in progress.

But leaving these old bottom rocks, unmistakably a part of the protaxis of North America and representing the most ancient foundations of the continent, we come to the great column of stratified rocks which constitutes one of the finest geologic series of the world, in which the progress of life is recorded as distinctly and with as few interruptions as perhaps in any other single section; as far, at least, as the base of the Carboniferous system.

The New York column is essentially a paleozoic column. All the great divisions of the paleozoic system are displayed in it except the Carboniferous and Permian and the latter are not altogether without representation.

Its main elements are of Cambrian, Ordovician, Silurian and Devonian time, with some representation, as indicated above, of the Subcarboniferous series. The divisions are given below in descending order.

Paleozoic	Carboniferous	Coal measures	Millstone grit
		Subcarboniferous	Mauch Chunk
	Devonian	Upper Devonian	Catskill
			Chemung
			Portage
		Middle Devonian	Hamilton
			Marcellus
		Corniferous	Corniferous
			Schoharie
		Oriskany	Oriskany
	Silurian	Lower Helderberg	Lower Helderberg
		Onondaga	Waterlime
			Salina
		Niagara	Niagara
			Clinton
			Medina
	Ordovician	Trenton	Hudson river
			Utica
			Trenton
		Canadian	Chazy
			Calciferous
	Cambrian	Upper	Potsdam
		Middle	Acadian
		Lower	Georgian

Of these several elements eight or 10 or more are sandstones. The best characterized sandstones are named below in ascending order. Potsdam, Hudson, in part; Medina, Oriskany, Portage in part; Chemung in part; Catskill, Pocono, Millstone grit.

Sandstones are the chief representatives of porous rocks and as such are the main repositories of underground waters, fresh or saline, and of petroleum and gas. All the strata named above serve in one or more of these several offices at some point within the limits of the state.

There are still other strata in the column which may contain water, oil or gas. Dolomitic limestones that have had a particular history are sometimes as porous as the coarsest sandstone. True limestones also in some of their phases show considerable storage capacity for gas and occasionally for water.

Porous dolomites seem to have resulted from the replacement of their rock substance. The first stage is pure limestone. Then by some change in the character of the sea water, magnesia is supplied in such quantity that it replaces one half of the limestone atoms, transforming the rock into a true dolomite. But the atom of magnesian carbonate is demonstrably smaller than the atom of calcium carbonate which it has replaced and if the original rock volume is maintained, vacant spaces must be left in the mass. Not all dolomites are porous. It is conceivable that dolomites originating in a different manner from that mentioned above may be compact and close grained rocks.

Concerning the reservoir qualities of limestones, we have not as good means of judging as of the rocks already described in which the porosity is a natural consequence of their physical state. Where limestones act as reservoirs there must be vacant spaces between the layers or beds of the stratum. That they are not true reservoir rocks is evident from the fact that they do not as a rule contain fresh or salt water in large volume. It seems probable, however, that the structural features of the strata contribute to the storage of gas.

CHAPTER 3

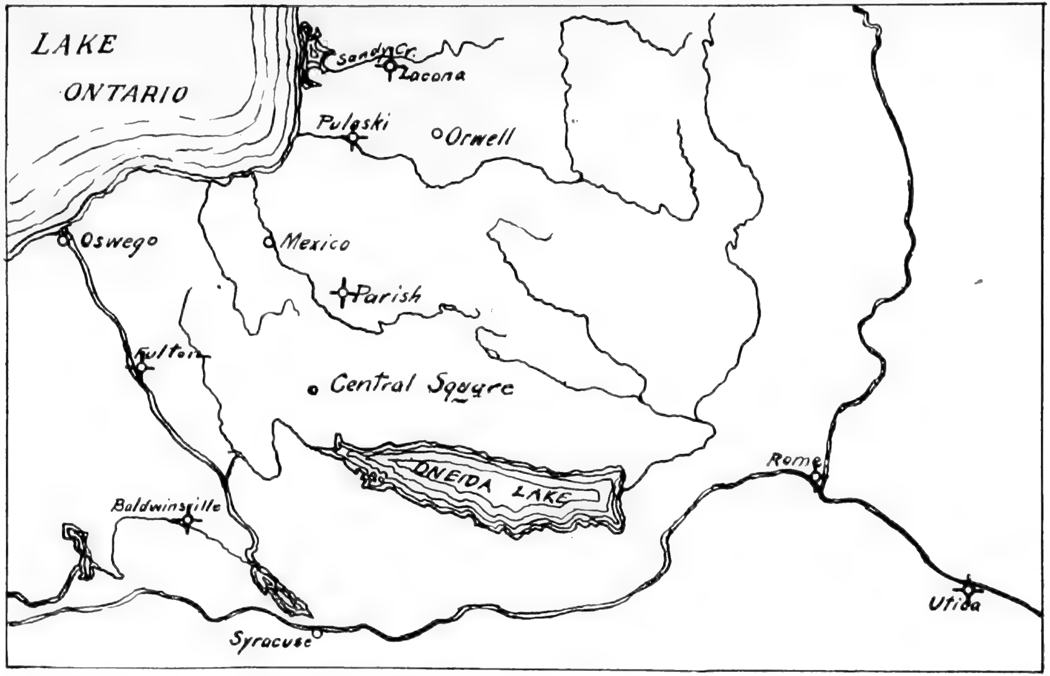
PRODUCTION OF GAS FROM THE LOWER FORMATIONS OF THE STATE

MEDINA, UTICA, TRENTON, POTSDAM

The discovery of petroleum on a large scale in this country was made at Titusville, Pa. in 1859. During the next few years explorations were eagerly carried forward and the geology of petroleum began forthwith to take shape. It was soon established that the great reservoir rocks of this region were sandstones or conglomerates that belonged to the Devonian age. The prompt but premature conclusion was at once reached by many of those interested in the subject that the natural home of petroleum was in the upper Devonian rocks of the geologic scale. But other horizons were developed as explorations proceeded and it was found necessary to include Subcarboniferous and finally Coal Measure sandstones among the sources of oil production and also to go lower in the scale and take in the middle Devonian as well.

With the geologic range as thus defined, namely from the middle Devonian through the Coal Measures, the drillers of western Pennsylvania and adjacent regions in New York, Ohio and West Virginia were content. Not an oil well was known outside of these limits and it came to be everywhere recognized as entirely practicable to determine on such a basis the regions in which the search for petroleum could be undertaken with fair prospects for success as well as the regions into which it would be folly to introduce the drill. This limit was practically in one direction only, namely, in descending the geologic column, for in eastern North America the Coal Measures are the latest formed and so the highest strata of the scale, with a few insignificant exceptions. But when Silurian or older rocks constitute the surface such territory was at once condemned, on the basis of the generalization above described.

The overthrow of this premature generalization came from northwestern Ohio in 1884-85 by the discovery of gas and oil in large amounts in the Trenton limestone. An immediate extension of the possible range of these substances was effected by this



Sketch map of central New York (in part).

discovery. It is true that an oil field of somewhat doubtful horizon and of rather insignificant production had already been developed in northwestern Ontario. The productive rock had been referred by Dr T. S. Hunt to the lower Devonian, and though this determination was questioned, the doubt was directed to a lower rather than a higher horizon, but no great weight was assigned to this oil field, so that the inclusion of the Trenton limestone among the productive oil rocks of the country came with a shock of surprise to both the scientific and the practical men interested in this question. The discovery carried the productive horizons of oil down several thousands of feet in vertical descent and enlarged the superficial area of possibly productive territory many fold. In fact, it transformed almost the entire area of the eastern United States into possible oil territory, so far as its range of rocks is concerned. The only regions excluded would be the Archaean district of New England, the Adirondack highlands, and the eastern or Blue Ridge portion of the Appalachian mountain system.

The Trenton limestone is by far the most widespread of any of the great sheets of stratified rock that make up this side of the continent and when it was recognized as a possible oil rock it carried over almost the entire country into this category.

Since 1884-85, the date of the discovery above named, one of the most important gas fields of the United States has been developed in the Trenton limestone of Ohio and Indiana, in regions where it lies 900 to 1200 feet below the surface and in the same region at a slightly greater depth one of the most important oil fields of the world has been brought to light, a field in which scores of six inch wells have each produced more than 100,000 barrels of oil, while single wells have passed the 200,000 barrel mark. The production of flowing wells has in many cases been at a rate of 10,000 barrels a day, and gas has flowed out from wells of the same size to the measured amount of ten, twenty and even thirty million feet a day. Entire farms have yielded oil to the amount of several thousand barrels to the acre. The initial rock pressure of the gas was between 400 and 500 pounds to the square inch in certain portions of the field. A total production of fifteen to twenty million

barrels of oil a year has been obtained in the Ohio and Indiana fields combined, in spite of determined attempts on the part of the Standard oil company to curtail production by depressing the price of crude oil below the point at which ordinary wells could be operated.

When the Ohio and Indiana fields were first studied, certain facts were brought to light in regard to the Trenton limestone that seemed greatly to restrict the promise which the announcement that this limestone is an oil rock would carry.

It was found that the petroliferous production was entirely limited to the uppermost beds of the formation, generally to the first 50 feet and never to more than 100 feet. It was farther learned that the beds in question had suffered in their history a change from true carbonate of lime to magnesian limestones or dolomites, and that the porosity of the limestones as attested by its holding gas, oil or salt water, was altogether dependent on this chemical change, beginning where it began and ending where it ceased. In other words, the dolomite corresponded exactly to the " oil sand " or " pay-streak " of the great petroliferous sand rocks in which we had hitherto found the principal stocks of oil and gas. The explorers of the new field all came from the old field and the identification referred to was universal. In composition the oil rock was in many instances found almost typical dolomite.

That the dolomite was not the original substance of the rock but a product of replacement was made evident from two lines of facts, namely: first, small insulated areas of true carbonate of lime that are sometimes found in the midst of dolomite districts; and, second, fragments of the oil rocks brought up by the explosion of torpedoes which show it to have been originally a crinoidal limestone. A stratum of this character must necessarily have been at the outset a true lime rock.

Farther, it was soon found that the productiveness of any portion of the field could be gaged with fair accuracy by knowing the thickness of the dolomite. It was also established that the areas within which the change had been accomplished were comparatively small and exceptional and that the great bulk of the Trenton limestone remained in its normal state, having a compo-

sition fairly represented in the following analysis (Trenton limestone—northern Michigan).

Carbonate of lime	82.00
Carbonate of magnesia	3.00
Insoluble residue	14.50

The composition of the dolomite, on the other hand, is shown in the following figures (Findlay gas rock).

Carbonate of lime	53.50
Carbonate of magnesia	43.05
Insoluble residue	2.96

Where the composition of the rock corresponded to the first table there was nothing to justify the application of the term oil rock to the Trenton limestone. It was seen that the dolomitic metamorphosis had taken place in only those portions of the limestone that were originally exceptionally pure in composition.

The conclusion seemed therefore justifiable that the storage quality of the Trenton limestone could be safely determined from its chemical composition. This conclusion applied to its great petroleum fields, namely, Ohio and Indiana, without qualification and holds good with respect to Michigan and Illinois as far as facts from these states have come in.

But subsequent observations and specially those to be recorded in the present report show that the conclusion must not be made general in its terms. It appears that the Trenton limestone holds considerable petroliferous accumulation in the form of natural gas in regions where no trace of the dolomitic replacement has occurred. In such districts it does not appear to be a true reservoir rock. It contains but little salt water and no continuity is apparent in such occurrences of the latter as are found. Nor does the water give indication of artesian pressure as in the oil fields of Ohio and Indiana.

Two principal modes in which gas is stored in rocks come into view in this connection. It is either stored in porous rocks, as sandstones, conglomerates or dolomites, in conjunction with other fluid, in which case it can be styled *reservoir gas*, or it is held in small spaces intervening between the leaves of shale or

limestone and then it may be designated as *shale gas*. The latter accumulations are quite likely to be found in pockets or distinct and unconnected areas that appear to be capriciously distributed.

Reservoir rocks follow geologic horizons closely. Salt water is found in such strata at certain points. Contiguous wells generally show approximate or exact equality of rock pressure and in them salt water rises to approximately the same level. The salt water is seen to be under artesian pressure.

Shale gas follows geologic horizons only in a general way. That the several bodies of gas or oil in a shale rock are not directly connected is evident from the fact that adjacent wells differ widely in the matter of their rock pressure. If salt water is found in them it occurs in small quantities only.

The discovery of the Findlay gas and oil seemed at first sight to turn almost the entire country into territory in which such production might reasonably enough be expected. The farther discovery of the dolomitic character of the really productive portion of the Trenton limestone seemed on the other hand to sharply restrict such possibilities. The last discoveries here to be described, do away to a considerable extent with the dolomitic limitations, and do something toward restoring the promise that the discovery in northwestern Ohio seemed at first to establish.

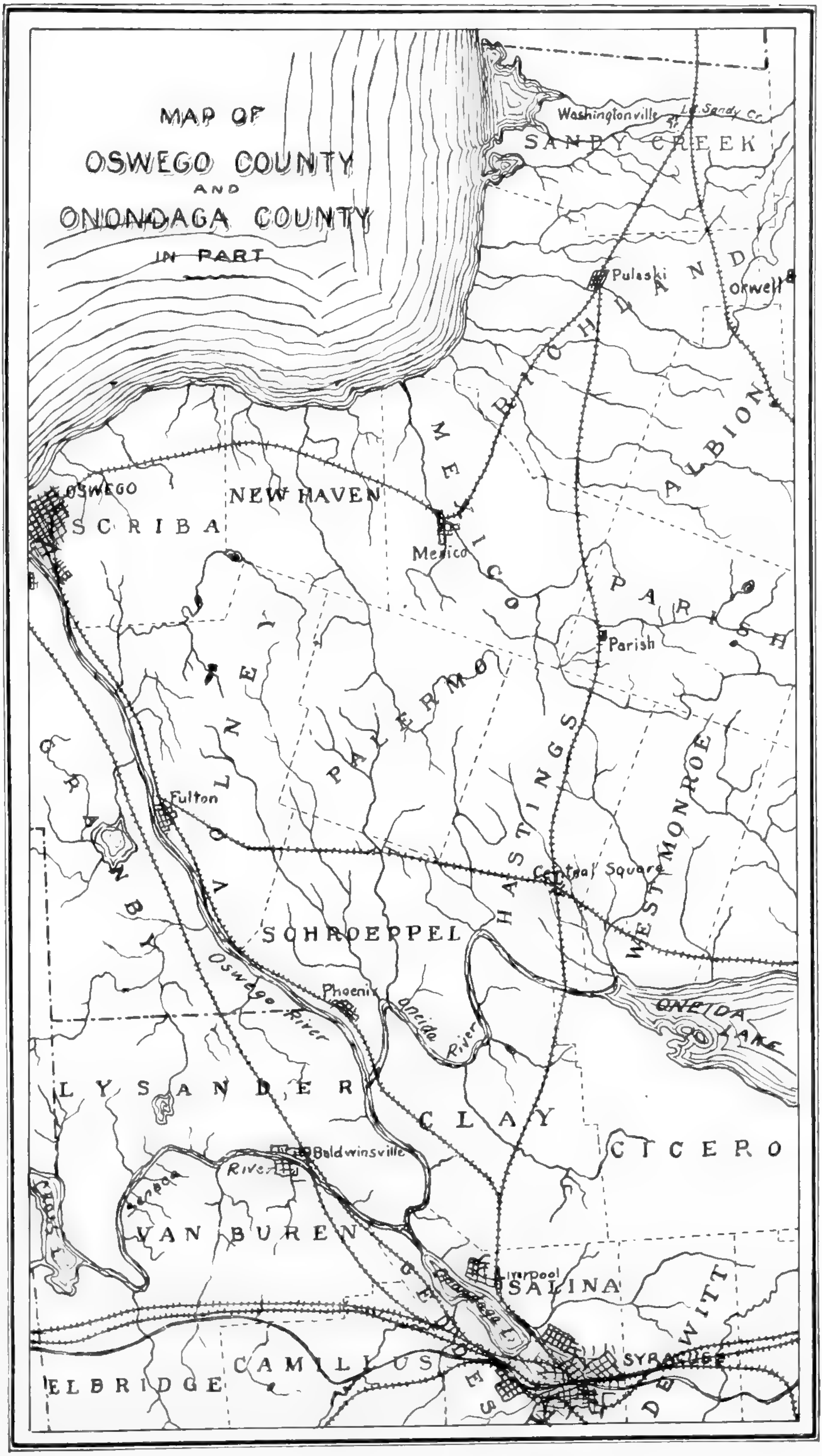
Section 1

Oswego county

Among the earlier explorations for the petroliferous series in this county are those which have been made during the last 25 years and notably within the last five years at Fulton. Search was also begun in 1888 in Sandy Creek, and in Pulaski soon afterward.

The experience that has been gained at these different points will be briefly described in the order named and reference will afterward be made to other localities in the county that have carried forward exploration by the drill in the search for the same source of wealth.

Geologic scale of Oswego county. The lowest rock that takes part in forming the surface of the county is the Trenton limestone, but its part in this office is very small. It is confined to


MAP OF
OSWEGO COUNTY
AND
ONONDAGA COUNTY
IN PART
Washingtonville
Lt. Sandy Cr.
SANDY CREEK
Pulaski
RICHLAND
Orwell
ALBION
MEXICO
Mexico
OSWEGO
NEW HAVEN
SCRIBA
PARISH
Parish
PALERMO
VOLNEY
HASTINGS
WEST MONROE
Fulton
GRANBY
Central Square
SCHROEPPEL
Oswego River
Phoenix
Oneida River
ONEIDA LAKE
LYSANDER
CLAY
CICERO
Baldwinsville
Seneca River
VAN BUREN
Liverpool
SALINA
GEDDES
DEWITT
Onondaga L.
SYRACUSE
CAMILLUS
ELBRIDGE

a few square miles in Sandy Creek township and belongs to the uppermost beds of this great stratum.

Above the Trenton the Utica shale and the Hudson river series appear in the regular order over which in due succession to the southward the Medina sandstone is found. The latter is perhaps the best marked element in the geology of the county. Above the Medina, the Clinton in strong force and the Niagara in feeble development, are added in ribbon-like bands around the southern edge of the Medina. But little of the surface rock of Oswego county is to be credited to the Niagara.

The two principal formations are the Hudson river and Medina groups. Over the rock floor the glacial drift is spread in an irregular sheet. Strong morainic features are shown in several parts of the county.

The rocky floor is dissected by the rivers that cross the surface of the county, affording fine exposures of the geologic series. The Oswego river affords a good section of the Medina at Fulton while the Salmon river gives a splendid exposure of the Pulaski or Lorraine shales, and the Oswego sandstone is well shown near Lake Ontario. The Oswego is a fine and steady stream that carries the waters from the Finger lakes of central New York to Lake Ontario. It has a rapid fall but is always clear, the lakes acting as settling basins for the inflowing streams.

a *Fulton*. Explorations of a random sort called attention to this region as a possible source of gas more than twenty years ago. A well was sunk partly on such expectations, on the Van Buren farm in the valley of the Oswego river, four or five miles north of the village of Fulton, for the purpose of a test. Surface indications had long been noted here, consisting principally in the bubbling of gas through the water in boggy spots. The thin accumulations of bog iron ore that cover with an iridescent film the pools of standing water were possibly counted among the surface indications. The latter have no possible significance as leading to valuable stocks of gas or oil and the bubbling referred to can in many instances be well enough accounted for by the decomposition of vegetable matter which is always going on in such locations.

But a shaft 4 feet by 4 was sunk to the rock, which was reached at 18 feet. The drill then descended into the rock,

namely, the Medina sandstone, a few feet. The well filled with surface water, but gas still bubbled through it. The bubbles were caught in an inverted butter tub, the bottom of which had been provided with a jet from which the gas, in this case probably derived from the Medina sandstone, was lighted and burned. The experiment stopped at this point, but it had given its testimony and this took effect on the minds of some of the more observant members of the community.

Eight or ten years thereafter the excitement over the wonderful discovery at Findlay, O., recalled this experience and led to the formation of a company of some of the more enterprising citizens of Fulton. T. D. Lewis was president of the company and J. H. Case, secretary, and these two gentlemen took the leading part in all the subsequent development.

The company proceeded to make a thorough test at the same point where the first well was sunk, availing itself of the 18-foot excavation previously made by Mr Van Buren. The drillers employed were naturally skeptic as to finding gas in this unknown series and did not use any precaution as to the exclusion of fire, such as would have been employed in a known gas district. Light flows of gas were however reached at various horizons and one of them was accidentally ignited from the forge in the derrick. This latter structure took fire thus and was destroyed. The derrick was rebuilt and the work resumed. The several formations of the region already noted were passed in due order and the Trenton limestone was struck at a depth of between 1300 and 1400 feet. At 1727 feet, well down in the last named stratum, a gas vein of considerable volume and force was reached. Drilling was continued to the depth of 2020 feet, or about 650 feet below the top of the Trenton.

The company had demonstrated the presence of significant accumulations of inflammable gas in the rock foundations of Oswego county, but had found nothing thus far that could be turned to economic account in repaying them for the considerable outlay they had already made.

Meanwhile exploration was going forward around them. The villages of Sandy Creek and Pulaski had already found gas in the Trenton limestone and were proceeding to utilize it.

The experience of these villages suggested to the Fulton company a new line of action. To recover if possible the losses already incurred, Messrs Lewis and Case and other members of the old company organized a new company to drill wells and supply the village with the new fuel. The necessary franchise was obtained from the village council, options were taken on 14,000 acres of land lying near the village, and new wells were at once begun.

The first well was located on the Vogelsang farm about one and a half miles southeast of the village center. The section as reported was found as follows:

Medina sandstone	400 ft
Oswego sandstone and Pulaski shale	880
Utica shale	120
Trenton limestone, upper surface at	1400

These figures are approximate but they serve well as a general statement. This record was well supported by carefully saved samples of the drillings. The latter were kindly placed at the disposal of the survey by Mr Case, secretary. Gas was struck in the red Medina and at various points in the Trenton. The largest supply was reached at about 1700 feet, the rock pressure of which was enormous. To determine this point an expert was brought on from Bradford, Pa. He found the pressure to be 1240 pounds. The well was left to blow wide open for one hour and when the valve was closed, a pressure of 500 pounds was regained almost instantly, and in $10\frac{3}{4}$ minutes 1075 pounds were registered. On being deepened a few feet the pressure is said to have run up to 1525 pounds temporarily. The total depth of the well was not far from 2500 feet. The cost of drilling was $1.25 a foot. The well was at first tubed with two inch pipe, but the company was advised to replace this by three inch pipe. In making the change, a considerable body of very strong salt water, which had seeped in from various horizons outside the pipe was released and lay on the gas rock for 36 hours; but the original pressure was practically regained. As soon as gas was struck the company set about piping the town. The work was done in haste and in September 1895, 164 consumers were put on the line. But this demand proved beyond the capacity

of the single well. The supply was short and the pressure fell rapidly away.

Well no. 2 was located on the R. K. Sanford farm, which adjoined the Vogelsang farm. This well is about 2000 feet from well no. 1, and is due east of the village center. It was drilled to a depth of 2383 feet. Gas was found as in well no. 1 throughout the Trenton limestone and its yield was steady from the first. It was at once turned into the village line and relieved the demand of the consumers for the time being. Well no. 3 was located on the Palmer farm and was due south of the Sanford well. It was drilled about 2000 feet deep and furnished a moderate amount of gas.

By this time the fortunes of the company had come to be so promising in the eyes of the business world that competition was introduced. The first exhibition of it was made by a company that called itself the Oswego river gas company. A trial well was located and drilled in the river valley at the north end of the village, but it found very little gas and the company gave up the search with this one unsuccessful trial.

A more important attempt to establish itself in what was coming to be counted a new gas field was made by a body of petroleum producers and drillers called the Eastern oil company of Buffalo. This company secured a lease on the Hoff farm and located a well not more than 500 feet from well no. 1 of the Fulton company. The well proved successful and the Eastern oil company thereupon offered the home company one and a half dollars for every dollar it had invested in the field. The offer was declined and the Fulton company bought instead the new well and connected it with its village line. This well will be counted as no. 4.

Well no. 5 was located on the same farm on which the first well was drilled and but 600 feet distant from it. This well proved a complete failure. It was practically a dry-hole.

The company now had five wells on its village line, but it had taken on new consumers as it increased the number of its wells. From the first it had been obliged to overtax its entire supply. Each well had been drawn on to its full capacity, and the service of the company had for this reason always been unsatisfac-

tory. The amount of gas steadily declined and on the whole rather rapidly, till after a few months it was no longer a safe reliance in domestic heating. Its inexpressible convenience led many to retain the use of it in cooking stoves, even though great inconvenience attended the short supply. For light also it continued to be largely used. Things have gone on in about the same way from that day to this. The valves of all the wells are opened wide to the pipe line. Every foot of gas that can be secured has been in sharp demand from the beginning.

The company has expended more than $38,000 on its plant. It lost its one opportunity, not only to recoup itself but to secure a handsome reward for its courage and enterprise, when it rejected the offer of the Eastern oil company referred to above.

Its first wells cost about $3000 each, but after a little the company purchased a set of drilling tools and employed its own drillers. By this arrangement the cost of sinking wells was reduced to 60 cents a foot, or less than one half the price first paid.

The company has on hand a plant of fair equipment and character for the distribution of gas. The village is enterprising and prosperous and gaseous fuel has already established its reputation there so that a large and promising market is assured if only an adequate supply can be furnished.

It is refreshing to find that in the location of the wells above described there was no recognition of any "theories" whatever, as men engaged in this line of business love to style their crude speculations and vagaries. There was no "northeast line" on which they depended, but they had leased a considerable acreage convenient to the village and the wells were located on these tracts solely as commonplace and intelligible considerations dictated. It is true that after drilling several wells the company began to consider that a line joining two of the best must be the line of promise, but nothing came from this crude conclusion. In locating well no. 5 the company, in urgent need of gas to supply its clamorous customers, thought to avoid all risk of failure by locating the new well not only close to no. 1, which was then their best well, but even between it and another producing well. No. 5 was the only well of the list that was an absolutely dryhole!

In the Fulton wells gas was found all through the descent, namely, in the red Medina, in the Oswego sandstone, the Pulaski

shale and the Utica shale, and most of all in the Trenton limestone. In the latter formation it was confined to no particular horizon except that the greatest stock was found 200 to 300 feet below its uppermost bed. Each minor accumulation of gas seemed independent of the rest. In one well 22 distinct accessions were recorded in a single day.

Neither sandstone nor dolomite are found in the section and salt water was struck in but a single instance in the entire experience of the Fulton company. There is practically no difference in the conditions of the gas, whether found in the Utica shale or in the underlying Trenton limestone.

The rock pressure of the gas is, however, enormous. In shale gas this element generally ranges low, though pockets are occasionally found in all the shales in which high figures may be reached. 200 to 300 pounds make a limit that is not often overcrossed. In the Fulton field the pressure ran up to the maximum of 1525 pounds, 1200 pounds being noted for some weeks in a single well.

The amount of gas from the wells of this series is comparatively small. As is well known, there is no relation between the rock pressure and the volume of wells. Wells of very small volume may reach very high figures in pressure. None of the Fulton wells proved themselves able to withstand the steady drain of the pipe line. Volume and pressure declined at once when the draft was put on them.

The question at once rises as to what use the gas discovery of Fulton could have been turned that would have brought profit to the company. As it is, a great deal of time and business energy and $40,000 in cash have been expended in the development and there is nothing whatever to show for it, so far as assets are concerned. The pipes buried in the earth could be recovered, it is true, but they could only be sold as junk. Practically the whole amount expended by the company can be counted as lost. Besides the expenditures named above a considerable amount has been expended in piping and equipping the dwellings of the town for the use of gas. Is there any possible use of the discovery that could have given to the community good returns in money value?

A well could have been drilled at public expense that would have furnished an ample stock of gas for lighting the streets and residences of the village for several years. So far as the streets are concerned the light would be so far inferior to the electric light in brilliancy that the change would not have been welcome to the people, even though a great saving in expenditure could be assured thereby.

Furthermore the system of distribution by which gas can be used for illuminating is already established in the village under private ownership. There could be no true economy in duplicating this system, and it would probably be impossible to secure the existing plant for the actual amount used in its establishment. If the coast were clear and electric light and gas companies were not already in the field a profitable use of the gas discovery could have been made by the village in the direction named.

For one use the way was open, namely, for domestic use, and that was naturally the line of service adopted by the new company, and in which it has lost its investment. Could this loss have been avoided? In the light of present knowledge the company can easily see how it might have followed a course that would have led to financial success instead of failure. If but one tenth the outlay in piping the town had been incurred and only one or two streets had been opened for this purpose and 20 or at most 40 consumers had been supplied with fuel, instead of 164 (the number on the line when the first well was finished) and if the gas had been sold by meter instead of by mixer rates, at a price commensurate with its value, the results might have been altogether different. Under these circumstances the wells would not have been overdrawn. Opportunities for resting them would have been found, and Fulton would still be rejoicing in a limited supply of the best fuel of the world.

The villages of Oswego county are not the only villages of the state to find natural gas within their precincts. Many discoveries of this kind are likely to be made in days to come. To learn by one's own mistakes is always hard and costly, but it seems possible so to record the facts in a case like that now under consideration that they can serve the interests of other communities that may find themselves in the same general situation.

No disinterested person with adequate knowledge of the experience that has been so abundantly accumulated within the last 15 years would advise such a course as the Fulton company pursued. It is possible to indicate a policy that would have returned the money invested and would have given to some hundreds of people the inexpressible advantages of gaseous fuel for several years.

Still another possible use of natural gas, viz, manufacturing use, is reserved for discussion in connection with the experience of other localities.

b *Sandy Creek.* The village of Sandy Creek is located in the township of the same name in the northwest corner of Oswego county. There are two sections of the village with an interval of about one mile between them. They are known as Sandy Creek and Lacona, and in earlier times went under the name of Washingtonville.

By a disastrous fire that visited the village 10 or 12 years ago, its one manufacturing interest, viz, a large tannery, was destroyed and nothing was found to take its place. The more enterprising of its citizens felt that something must be done to arrest its discouragement and decay.

The Trenton limestone excitement that began with the experience at Findlay, O., in 1884, was already under way and, as surface indications, probably of the bog gas variety already referred to, were found here, and as drilling though unsuccessful had been undertaken at Watertown, in the county north, it was determined in 1888 that a test of the rock should be made here. A company was formed under the name of the Sandy Creek oil and gas company, limited. It comprised the best citizens of the village and took in also many of the more intelligent farmers of the neighborhood. The capital of the company was placed at $5000 and the stock was sold in shares of $10 each. There was a large number of subscribers and the burdens of all were light. O. R. Earl was elected president and Gilbert N. Harding secretary.

The company bought the drilling outfit that had just been in unsuccessful operation at Watertown. It also entered on the leasing of land on quite a large scale. At first an annual rental of $5 an acre was paid till drilling should be undertaken on the

premises. For each completed well, if successful, a rental of $25 a year was to be paid. About 13,000 acres were taken up, but the rate of rental was soon reduced to $1 an acre annually and has since been cut down to still smaller figures.

The first well was located in the valley of Sandy Creek between the two villages. The rock at this point is overlaid with only a very shallow covering of drift. A little gas was struck when the rock had been penetrated a few hundred feet, but presently the drilling tools got fast and the company, being dissatisfied with the contractor, shut down the work. The next year, 1889, operations were resumed under a new contractor. The tools were got free and the drilling was carried deeper. More gas was struck as they descended but the rock pressure was comparatively feeble, reaching only 80 pounds to the square inch. Several pockets of gas were struck as the drill went down, in which much higher pressure was shown. At times water froze around the tools, owing to the rapid expansion of the released gas. The village was forthwith piped and the utilization of the gas was begun in the same year.

The use of the new fuel has gone forward without interruption to the present time and this first well has played an important part in the supply. In August 1897, its pressure was found to be 60 pounds, a fall of but 20 pounds in eight years of large but not constant use. Its pressure has sometimes been higher than when the well was first opened, suggestive of the idea that it may be borrowing gas from other areas of rock near by. The highest figure that has been noted is 100 pounds. When the well is steadily used the pressure declines, but by resting, it is usually restored. This well has proved an excellent supply. It is good for 30,000 to 40,000 feet a day. The company has drilled 18 wells in all, and so far has discarded but one as without value. Salt water has been found in but two of the number; in one of them at 900 feet and in another at 35 feet below the top of the Trenton.

Well no. 2 is located one half mile down the creek. It was drilled to a depth of 1080 feet. In its early history it met with a misfortune by which its value has been impaired. The casing collapsed and the well was flooded with fresh water for some time. It has not proved as valuable a source of gas on this ac-

count as no. 1. Well no. 3 was located one half mile directly east of no. 2. It was drilled to a depth of 1100 feet and proved a fairly successful well. It has been on the line for the last seven years. Well no. 4 was also drilled to a depth of 1000 feet, its location being one half mile directly east of no. 1. It had 40 pounds of rock pressure when completed. It was never tubed but was packed in the casing. It holds its original pressure, after being shut off from the line for a few weeks.

Well no. 5 is one of the two deep wells of the company, having been drilled to a depth of 1265 feet. It has proved a fair source of gas. Its initial rock pressure was 50 pounds. Under the steady draft of the pipe line in winter the pressure falls to 25 or even to 20 pounds, but when rested a few weeks it regains its old figure. Well no. 6 is three fourths of a mile south of no. 1. It is also a fair producer. Its initial pressure was 70 pounds. Well no. 7 is one and a half miles south of no. 3 on the Pulaski road. At 900 feet salt water in large amount was struck at the level where gas is found in many other wells and both products were delivered by the tubing at the same time. Its rock pressure was 250 pounds. Its usefulness was interfered with by the presence of the water, though, of course, a separation of the products is possible.

Well no. 8, one half mile southeast of the village center, had an initial rock pressure of 40 pounds. Well no. 9, one half mile east of the village center, had 105 pounds initial pressure. Well no. 10 is one half mile east of no. 9. It was counted a good well when completed, but it does not seem to have the staying properties of many of the other wells. It is obviously losing ground under use, its pressure not rising above 20 pounds at the date of observation in 1897. Well no. 11 is three quarters of a mile south of no. 1. It met with bad fortune at the outset. A pocket of gas was struck which was under a high pressure. The drilling tools were blown out of the well and the cable cut by the flying chips. The well was packed in the Trenton limestone instead of in the overlying shale. It has never been equal in production to the best wells of the company. At the end of one and one half years of use it shows, however, a rock pressure of 50 pounds. Well no. 12 is located in the valley of Sandy Creek,

one half mile northwest of no. 2. It has proved an average producer and now holds a pressure of 70 pounds.

Well no. 13 was one half mile west of no. 2. It has proved a fair average of the series to which it belongs, and holds a rock pressure of 70 pounds while in use. Well no. 14, one half mile northeast of the village center, is but 900 feet deep. It reached the top of the Trenton at a depth of 600 feet. A pocket of gas was struck, the tools were lost, and the casing blown out. The well has proved a good one but is losing volume at the present time. Well no. 15 is 1000 feet deep. It is located one half mile north of no. 1. It has proved one of the best wells of the series. It has been an important contributor to the supply of the line for two years, and when rested, promptly recovers at least a large part of its original pressure. Well no. 16 is 1000 feet deep. It reached the Trenton at 400 feet and has proved a fair well. Well no. 17 has recently been completed. It shows a rock pressure of 100 pounds. It reached the Trenton at 385 feet, and shows a good volume of gas.

One well that was drilled by the company produced so small a quantity of gas that it was never connected with the pipe line. It would have completed the list of 18 wells, above given.

Throughout this region the drift is shallow, not more than 10 to 25 feet of drive pipe having been called for in any instance, and in the valley locations the superficial deposits are often less than five feet.

The wells are all located within a circle two miles in diameter, the farm lands contiguous to the village having been generally leased for this purpose. They do not appear to draw on each other, and probably the number could be considerably increased within the limits named.

The uppermost member of the rock series is the Pulaski shales, under which the Utica shales are found. The latter are 250 to 300 feet in thickness. The thickness of the Pulaski shale varies greatly according to the altitude of the surface, which declines rapidly to the westward. In some instances there is less than 100 feet to be credited to this division. The Trenton limestone, when shallowest is found at 385 feet, and when most deeply buried, at 600 feet. The wells are generally finished at 1000 feet. The only deeper wells were carried down to 1200 and 1265

feet respectively, but no advantage was gained by drilling the last 200 feet. In the 1200 foot well, the last thing struck was a very gritty rock, but underneath it limestone again appeared.

There is no definite relation between the gas volume and the rock pressure of a well. A well with low pressure may contribute to the line steadily and well through a long period. Of the daily production or capacity of the wells no record has been kept, but the superintendent counts 100,000 cubic feet as the unobstructed production of a good well for 24 hours.

Gas is not found in definite horizons, but is mostly confined to the Trenton limestone. It is likely to be found in small amounts when the drill has sunk but five or ten feet into this formation. From the surface downward till 600 feet of the series have been traversed, there are innumerable accessions of gas, the best of the flows being found in the lower part of the formation.

The dip of this stratum is strongest to the southward. On a southwest line of six miles between Sandy Creek and Pulaski the surface of the Trenton falls 150 feet, or 25 feet to the mile.

In the last year the metered output showed the production of the wells to be 17,280,000 cubic feet of gas. Probably enough gas was used or lost outside of the meters to make the total 18,000,000 feet.

The gas is sold at the nominal price of 35 cents a thousand, but a discount of 10 cents is allowed for prompt payment of bills, so that in reality the price is 25 cents a thousand cubic feet.

The use of the gas is exclusively confined to house service. In the severest weather there is occasionally a temporary shortage in the morning hours, as the mains are but three inch pipes, but on the whole the supply is eminently satisfactory to all the patrons of the line. For the last three years the service has been nearly perfect.

In the location of the wells the aim has been to keep them approximately one half mile apart, but no theory whatever has affected the location and no "lines" or "belts" have been developed by the experience of the company thus far. In this respect, as in all others, the gas conforms exactly to the characters of shale gas.

It is of vital importance to use the wells alternately. A well kept on the line for months without relief loses pressure and volume, but a few weeks rest is generally effective in restoring both.

The original capital stock of the company, as has been said, was $5000, but this amount has since been raised to $15,000 and the company has considerable debt besides, but it is paying its obligations as far as possible out of its income, which latter is about $4500 a year, and all of which is used on the plant. No one looks for any return of the amount originally invested.

The experience of this village has been highly satisfactory. The community has now enjoyed for nine years the inexpressible convenience and luxury of natural gas for fuel and light. To every household using it there has been a distinct increase of the comforts of life, and a distinct diminution of its discomforts. There has also been for all stockholders in the company an annual reduction of the cost of fuel and light that will go far toward repaying them for the original investment.

It is hard to see how the fortunes of the village could have been improved by any different management. All the work has been carried on soberly and sagaciously and without illusions or self-deception or "booms" of any sort.

The example of Sandy Creek in its use of natural gas may well be taken as a model for all communities similarly circumstanced. The character of the gas as shale gas is unmistakably displayed in the record above given. The lack of definite horizons, the frequent occurrence of pockets, the absence of salt water, the want of agreement as to rock pressure in the various wells, even in those nearest to each other, are all marks that admit of but one interpretation.

c *Pulaski.* This village was inspired to undertake the search for natural gas by the successful experience of the neighboring village of Sandy Creek, above described. It had also grounds of encouragement of its own. "Surface indications" had long been known in the form of escaping gas. The best known locality was a small but picturesque island in the valley of the Salmon river, adjoining the corporation. Many outcrops of the rocks occur on this island, and from some of the natural joints it has long been known that gas was escaping and could be

lighted. The island is used as a park and is known as Island grove. The surface rocks of the region belong to the lower portions of the Hudson river series. One of the names assigned to this division by the New York state geologists in their first system of nomenclature was drawn from this very locality, namely, the Pulaski shale. Another name proposed for the same section was the Lorraine shale. This designation was drawn from the fine exposures of this rock in the town of Lorraine, Jefferson co. where the series has been dissected by the gorge of Sandy Creek.

The Salmon river section of the Pulaski shale is 40 to 50 feet in thickness, within the village limits. It is made up principally of sandy and calcareous shales in which the characteristic fossils of the formation are well and abundantly displayed. There is very little material in the section that can endure exposure to the weather. Occasionally a layer is found that does not immediately disintegrate and such are used to a considerable extent in unimportant masonry.

Farther up the stream a much longer and finer section is to be seen at the falls of the Salmon river in Orwell township. The Medina sandstone occurs in force in this township, and possibly the Oswego sandstone also. The sandstone is best seen in what are called the Grindstone quarries.

The mantle of drift is nowhere of great thickness and it adapts itself in a general way to the topography of the rocky floor on which it was deposited. The general level of the town is somewhat more than 100 feet above the level of Lake Ontario.

A company was organized in the spring of 1891 made up of public spirited citizens. Louis J. Clark, president of the First national bank, was made president of the exploring company.

The first well was located on Mill street. At a depth of 559 feet a flow of salt water and gas was reached. The water was thrown above the derrick in a milky shower which continued for about 24 hours. At 980 feet a blower of gas of great force was struck, in the night. It not only lifted the drilling tools but carried out the casing and tubing as well and packed the cable so closely in the casing that it was necessary to use an axe on the latter in getting it free. The salt water that had been found at a higher horizon accumulated on the lower gas rock and nearly ruined its production.

The well was, however, recased and retubed and it still supplies an insignificant amount of gas, barely enough for the demands of the single residence with which it is connected.

A second well was at once located about 300 feet east of the original location. In this well no salt water was encountered and at 980 feet, the horizon of the pocket in well no. 1, only a small puff of gas was found. The drill was kept at work till a depth of 1500 to 1600 feet was reached. Small additions of gas were made from day to day as the tools descended, but the total yield was small, only enough, as the event proved, to supply the single family of the farm on which the well was drilled. This well was cased at 125 feet, but not quite low enough to exclude the fresh water altogether. It was found necessary to blow out the well every few months, and in wet seasons, oftener. The drill was stopped in this well at a depth of between 1500 and 1600 feet and, as was learned by later experience, had been carried almost to the granite.

By the drilling of these two wells, it had been demonstrated that gas was to be found in the rocks underlying Pulaski, but there was naturally some hesitation on the part of the company in undertaking the additional expense required for the utilization of its discovery. At this point one member of the company, namely, Mr Charles Tollner, grew impatient with the delay and determined to carry the work forward at his own expense. He accordingly bought out the stock and franchises of the old company and proceeded forthwith to pipe the village for the use of gas, even in advance of farther tests. He took drilling options on a large area, (15 to 20,000 acres) surrounding the village. The limit of the option was 10 years and for every well accepted, $50 a year was to be paid.

Mr Tollner was a manufacturer who had established a large and successful business in Pulaski. He had accumulated a handsome fortune for this region by his energy and sagacity and was beyond question the leading business man of the community. He had something of the idealistic temperament as well and the idea of turning to practical service a stock of power buried beneath the surface, of which he was one of the discoverers, appealed strongly to his imagination.

In piping the village no expense was spared that was counted necessary to the most satisfactory service. In the size of the pipe, the quality of the connections, the regulators, etc. the best rather than the cheapest were in all cases selected.

It will be remembered that though two wells had been already drilled, there was not a large quantity of gas that could be depended on. The first well was a failure and the second well imperfectly cased, but both had proved the region to be gas-producing territory. To fill the pipes now laid in the streets of Pulaski new wells must be drilled, and Mr Tollner next set about this part of the work. He undertook it in the same spirit in which he carried on the piping of the town, paying full price for all the work, and neglecting to avail himself of the economies which competition would have insured.

When his first well was completed, the gas found in it was at once turned into the village lines and utilized by householders who had prepared their dwellings for it.

Mr Tollner drilled 20 wells and bought one that had been drilled by outside parties (the Eastern oil co. of Buffalo) within the territory which he occupied. The driller in charge of all of his later work was Mr W. O. Potter who came in from the Pennsylvania oil fields. From him and from other drillers and from the samples of drillings saved in the process of the work, the following general section can be taken as embodying the principal facts as to the Pulaski wells. The same section will serve for much of Oswego county.

Pleistocene	Drift	0– 96 ft
Ordovician	Pulaski shale	200– 250
	Utica shale	100– 250
	Trenton limestone	600
	Calciferous	200
Cambrian	Greenish sand (Potsdam ?)	10– 40
	Black limestone (called "black granite" by some drillers)	20– 40
	Greenish sand	5– 10
Archaean	Red (orthoclase) granite struck at	1400–1500

The Trenton limestone is struck in this field at an average depth of 550 feet. Most of the Pulaski wells are drilled to a depth of 1000 feet, but enough have been carried to the granite

to establish the general order of the several strata that underlie the Trenton limestone. The first gas is sometimes found in the Pulaski wells only a few feet below the top of the Trenton limestone. Beginning at 20 feet in this formation, accessions are often found every 10 to 15 feet for the first 100 or 200 feet. This is called the first vein. Below this depth, larger and more persistent veins are found and they are liable to be struck through much of the remaining portion of the Trenton section. This is called the second vein. It is generally reported at about 1000 feet.

The initial rock pressure of the Pulaski wells ranges between 165 and 650 pounds. But a single example has been noted in which the highest figure was reached. The pressures of the several wells when first completed were as follows: 170 lb., 250 lb., 600 lb., 400 lb., unproductive, 325 lb., 400 lb., 165 lb., 250 lb., 400 lb., 390 lb., 600 lb., 400 lb., 170 lb., 650 lb., 600 lb., 500 lb., 170 lb.

No figures were obtained as to the daily gas production of a new well, and no opportunities for measurement were found, but a few tens of thousands of cubic feet will cover the production of all except the very largest wells.

A brief account of the Tollner wells, 20 in number, will here be given.

Well no. 1 was located on Island grove already referred to, of which Mr Tollner was the owner. This well was begun on July 4, 1893. The well was drilled by O'Donnell & Rick, experienced Pennsylvania drillers. The Trenton was struck at 550 feet. The largest gas vein was not reached till a depth of 1050 feet had been drilled. A rock pressure of 170 pounds was observed at this point. The well was not carried to a greater depth.

Well no. 2 was located one half mile northeast of no. 1. It was drilled to a depth of 1100 feet, when a pressure of 225 pounds was reached. Two main veins of gas were found, one at 800 feet and the other at 1000 feet. Of these veins the last was the stronger. The Trenton limestone at the point where the drill was stopped, was black, a phase which it takes on at the typical locality, Trenton Falls.

Well no. 3 was located on North street, one half mile due north of well no. 1. It proved much more productive than either of its predecessors. Its first strong vein was found at 700 feet

and its second at 1100 feet. It was drilled to 1150 feet in depth. Five hours after it was packed it showed a rock pressure of 500 pounds, and in three days 600 pounds were registered. When the gas was turned into the village line there was some water in the pipe which was frozen by the rapid expansion of the gas. In thawing the pipe fire was accidentally communicated to the well, and a considerable demonstration followed. It was some time before the well was again brought under control. Its rock pressure never rose above 400 pounds thereafter. In the winter of 1896-97 the pressure was drawn down to 35 pounds, but though subjected to a long-continued and steady draft, it did not fall below this figure. Well no. 4 is located one half mile northwest of no. 1. At 650 feet a powerful gas vein was struck. The cable was cut by flying chips and the drilling tools were lost. The gas showed a rock pressure of 400 pounds and the well was not drilled deeper. In the winter of 1896-97 the pressure did not fall below 40 pounds. Well no. 5, located to the southeast of no. 1 was drilled to a depth of 1200 feet but only an insignificant amount of gas was found there. It was the first example of a dry hole in this field. Wells of this character are popularly and jocularly known here as "post-holes." If the well had been tubed, possibly gas enough for a single residence could have been obtained from it.

Well no. 6 is located one and one half miles from no. 1, and directly north of the village center. At 700 feet, gas enough for the drilling engine was struck, and at 1150 feet a powerful vein was found. It raised the tubing, but the clamps struck the casing and thus were stopped there. The tools were left in the well, which was packed at 600 feet. 300 pounds rock pressure was noted when the well was renewed. Well no. 7 is three quarters of a mile due north of no. 6. At 650 feet it found gas enough for the boiler of the drilling engine. A second vein was reached at 1000 feet and this grew steadily stronger till 1150 feet was reached, when a pressure of 450 pounds was registered. Under steady use it is drawn down to 50 pounds, but the impression among those who have the care of the line is that no. 7 supplies a larger volume than any other well of the field. Its production has been estimated at 100,000 cubic feet a day, but the grounds on which the estimate is based are not understood.

Well no. 8 is seven eighths of a mile due north of the village. It is 1200 feet deep and has furnished but little to the pipe line. Gas was found at 650 feet, but not enough for the boiler of the drilling engine. A second vein was struck at 1100 feet, the pressure of which rose to 165 pounds. Well no. 9 proved the second dry hole of the series. It is located three eighths of a mile north of no. 3.

Well no. 10 was drilled by the Eastern oil co. of Buffalo and was bought in by Mr Tollner. It is one half mile north of no. 4. The first important vein of gas in this well was struck at 600 feet. The well was finished at 1050 feet. It behaves differently from any other well of the series in respect to rock pressure. On one day it will show 125 pounds, and on another, perhaps but 25 pounds, and there is nothing apparent in the condition to explain this difference. Well no. 11 is three fourths of a mile north of no. 4. At 650 feet, gas enough for the boiler was found. At 1000 feet an uncommonly good vein was struck. This well showed a pressure of 400 pounds, after being shut in four hours.

Well no. 12 was drilled to the granite, which was struck at 1425 feet. It also was destitute of gas, the third in the series thus far. At 180 feet in the descent a strong vein of slightly mineralized water was struck. It continues to flow from the well mouth as a spring. Well no. 13 is located on the bank of Salmon river near the lake, three fourths of a mile from no. 11, with the record of which it is in close agreement. In fact, the records of the two wells as to horizon, pressure and apparent volume are nearly identical. They rise and fall in pressure together and it would appear that they have some underground connection. They are both among the good wells of the line, making an important contribution to the supply of winter gas to the town. They are rested by being shut off from the line five months in summer.

Well no. 14 is the fourth dry hole out of the 20 wells drilled by Mr Tollner. It is 1300 feet deep and no account whatever is taken of it. Well no. 15 is three eighths of a mile west of no. 4. It lies between nos. 4 and 11. It was drilled in 1895. The first gas was struck at 600 feet and the last at 1100 feet. It shows a pressure of 400 pounds and apparently has good volume. Well no. 16 is another of the good wells of the circuit.

It showed a pressure of 600 pounds when the lower gas vein was struck at 1175 feet. Well no. 17 is found to be affected by a considerable dip of the strata to the westward. It is a half mile west of no. 16 and is 1200 feet deep. The main gas veins were struck at 700 and 1175 feet. The lower portion of the Trenton limestone was black, as in one case previously reported. This well shows 170 pounds maximum pressure, but its minimum pressure thus far has been 130 pounds, even under steady use.

Well no. 18 is three eighths of a mile west of no. 17. It is one of the good wells of the series, holding its pressure under severe use better than any other well of the line. Its maximum pressure is 650 pounds, and at the end of the winter it does not fall below 260 pounds. The first gas was found at 650 feet and at 1175 feet the volume and pressure were so satisfactory that drilling was suspended there. Well no. 19 is three eighths of a mile still farther west than no. 18. It is 1150 feet deep and got its first gas at 675 feet or 25 feet lower than no. 18. Its full pressure is 600 pounds and thus far it has never been reduced below 300 pounds.

Well no. 20 is still farther west three fourths of a mile beyond no. 19 and on the lake shore. The westward dip of the strata carries all the horizons a little lower. The well has good volume and good pressure. It is 1325 feet deep and obtained its last flow of gas at 1300 feet. It has a final pressure of 500 pounds and after being shut off the line continues to gain for a full month. It is a good gas producer as compared with the other wells with which it is associated. Well no. 21 is located near the original group of wells east of the village. It is situated northeast of no. 2. The Trenton limestone was struck at 575 feet and at 650 feet a blower of great force was struck. The well was carried to a depth of 1075 feet but all of the lower portion of the Trenton proved unproductive, no second vein of gas being reached.

The price for drilling these wells was $1 a foot. It could have been considerably reduced by inviting competition. Of the 20 wells drilled by Mr Tollner, four were dry holes, as has been shown in the preceding records.

The wells farthest from town are four miles distant. The nearest are just outside or even within the corporate limits. The

plan pursued has been to keep the nearest wells for winter supply, but various causes come in to modify this practice. Every well is expected to give at least one month's service in a year.

The gas is used exclusively for domestic purposes and is all sold by meter at the rate of 25 cents a thousand feet. There are approximately 250 residences depending on the line for fuel and in many cases for artificial light also. The supply has been from the first adequate and satisfactory, barring the severest mornings of the winter, when the pipes are liable to be overtaxed for a few hours. Gas has displaced other fuel in town largely. The price of wood has fallen from $2 to $1.25 a cord.

There are four regulators on the system, set at the four cardinal points. The north regulator receives the gas of four wells; the south and the east regulators each receive the gas of two wells; the west regulator takes the gas from all the western wells which include the most productive of the series.

The amount of gas consumed in each of the winter months is about 4,000,000 cubic feet or an average of 133,333 cubic feet a day. There are about 300 meters in use. The amount of gas paid for from Aug. 1, 1895, to Aug. 1, 1896, was 25,000,000 cubic feet. This gas was all supplied by the first 11 wells. For the year 1896-97, the amount of gas used was 35,000,000 cubic feet.

The price of the gas, 25 cents a thousand, is certainly much below its intrinsic value. It is cheaper, all things considered, than wood at $1.25 a cord, but the people had no reason to complain when they were obliged to pay $2 a cord and be at the expense of cutting it besides. Counted on this basis, the price should be 35 cents a thousand.

Mr Charles Tollner, the founder of the Pulaski plant, died in the summer of 1897. He has invested between $50,000 and $60,000 in this business. Some of his heirs declare that the investment from a financial point of view was a mistake. The gross income, it is true, is a little more than 10% on the money invested. But new wells are required to maintain the supply, and supervision, rentals, repairs and other necessary expenses leave nothing to be returned to the Tollner estate. If the price of the gas were increased 50% or 100% there would be a possibility of some return as interest on the money invested, but even then it would be necessary to face the fact that the cost of maintaining the plant

would be constantly increased and that at no very distant day the gas supply will be exhausted. When this time comes, the $60,000 invested in the field will be an almost total loss. As long as the supply is maintained at present prices, the Tollner estate may be considered as donating the interest of $60,000 annually toward paying the fuel bills of two or three hundred of the most prosperous citizens of Pulaski. It is deemed proper to call attention to these points, for the example and experience of Mr Tollner are often so quoted as to make his case seem wise and sagacious from a business point of view.

Other deep wells have been drilled in various parts of the county, under the impulse that has already been described. No results of economic interest have been reached by any of these explorations but geology finds something of value and interest in their record.

d *The Stillwater well.* A well was drilled in 1897 in the southeastern part of Orwell township. It was located on the west bank of the Stillwater creek, by which name the Salmon river is known above the falls. The well site is higher than Pulaski by a little more than 500 feet. The record of the well is as follows:

Drive pipe	37 ft
Sand and shale, (cased at this depth)	255
Oswego sandstone	90
Pulaski shale	530
Utica shale	113
Trenton limestone, struck at	925
White Trenton	300
Dark Trenton	370
Sand and shales	40
Sand, green and white	25
Black limestone	6
Red and white sandstone, calcareous	18
Granite, struck at	1 697

The granite was drilled into for five feet. This record shows but 772 feet between the top of the Trenton and the granite. In other sections 100 feet more has been found for the same interval.

The record below the Trenton in this well was specially interesting and valuable. Good sized fragments of the greenish white sandstone and also of the black limestone were brought up by the sand pump. The limestone was examined microscopically by Dr J. M. Clarke of Albany, who reports it as a true brecciated limestone carrying a little phosphate of lime. Fragments of shells of Obolella and Lingulella are recognizable in it and, more doubtfully, fragments of trilobite crusts. The fossils named agree with the stratigraphic position of the limestone, which is of Cambrian age and not far removed from the Potsdam sandstone. Probably the sandstone overlying it belongs to the last named formation.

At 45 feet in the Trenton, namely, at 970 feet, a light vein of gas was struck and a slight increase was noted also at 1045 feet, but beyond this there was no sign. This well was drilled under the direction and inspiration of C. W. Vroman, who has had much experience in the oil fields of Pennsylvania and Ohio and who has been prominent from the first in the test wells of central and northern New York. The Orwell well was located in part on a theory. A little amber oil is said to have been found, emerging from a bed of sand which is the source of a spring in the township of Greig, Lewis co. The oil was believed by those who reported it to be native to the location. The sandy drift was 40 feet thick, but whether derived from a sandstone disintegrated in place or from glacial deposits has not been made clear. The first rock formation beneath this sand is the granite of the region. A well was drilled here over 800 feet into the granite.

This little show of oil has made a great impression on several of the drillers who have been at work in this region and has led to the spending of many thousands of dollars. It will scarcely be believed, but such is the fact, that this light surface indication, which may be the result of a deliberate attempt to deceive and not natural at all, has been counted the evidence of a new geologic horizon of oil which it may be worth our while to investigate. Lines have been drawn on maps of varying scale and having indefinite degrees of inaccuracy, connecting this little spring in the North woods with the great oil fields of Pennsylvania and a charm has by some been supposed to lie in points

that are found on such a line, when its direction is half way between north and east.

The geologic absurdity of all this it is impossible to overstate, but such is the natural desire of the mind for rational guidance, or at least for the semblance of such guidance, instead of mere guess work, that men intelligent enough in other respects have taken up the 45° and $22\frac{1}{2}$° lines as if they could give a clew to the accumulations of oil all the world over.

The fact that a sand rock overlying the granite was struck in several wells of the county and that in one of these to be described hereafter it held a considerable supply of gas, is also to be taken into account. The location of the Orwell well is best explained by the statement of these facts.

The Potsdam sandstone is unquestionably a widespread stratum in the underground stratigraphy of this portion of New York, but thus far no petroleum has been reported in any of its unmistakable occurrences.

The Stillwater well gave new data for the measurement of the dip of the strata. The descent of the Trenton from this well to Pulaski is about $12\frac{1}{2}$ feet to the mile in a due west direction. The southward element of the dip is much stronger.

e *Mexico.* Another deep well was drilled at Mexico, a dozen miles southwest of Pulaski. The Trenton was found at 1027 feet, and the well was carried to granite at something less than 2000 feet. Small gas veins were struck at 1300 and 1400 feet but no economic value was attached to the discovery.

f *Parish.* An immensely interesting record has been obtained from drilling in this town. A deep well was put down here by the Eastern oil co. of Buffalo, the operations of which have been before noted. The management of the work was in the hands of Charles W. Vroman, who later drilled the Stillwater well, already described. Drilling was begun on the Parish well in 1895, inspired by the experience at Sandy Creek and Pulaski. The show of oil at Greig is said to have figured also in this location. Some of the operators who were making explorations in this region were sanguine that oil would somewhere be found in a stratum that had proved to be so important a gas rock as the Trenton limestone. Such a conclusion seemed warranted by experience, for in all the great fields every good gas rock has at

some point been found to be a repository of oil as well. It does not, however, follow that there can be no exceptions to this general rule.

The first well was located on the Carley farm, two and a half miles southeast of the village of Parish. It was drilled to a depth of 2000 feet and but very little gas was found. The depth at which the Trenton was struck is uncertain, but at 2000 feet the company that was carrying forward the work proposed to abandon the test, but the derrick was left standing. Meanwhile, another well had been drilled a few miles west at Central Square, in Hastings township, and the drill had been carried down to the granite, which was reached at 2450 feet. Between the Trenton limestone and the granite an interval of 150 feet was reported. The sandstone already named (Potsdam) was found in this interval and to drillers familiar with the Pennsylvania oil sands, it seemed to belong to the same class. Its clean and open grain was adapted to ample storage of water, oil or gas and these facts, taken in connection with the discovery of oil in Lewis county, before described, were thought by experienced oil producers to justify a farther search in this neighborhood. This deep sand was likened to the McDonald sand of western Pennsylvania and great expectations were built on the resemblance.

A few weeks after the first well at Parish was abandoned one of these sanguine operators returned to the village and offered to drill to the granite if citizens would cooperate. $400 was subscribed by the people and the drill was again set in motion. The hole was deepened 120 feet, carrying its depth to 2140–50 feet, when granite was reached. The latter was penetrated to a depth of 7 feet. In passing through the interval below the Trenton limestone, the same series previously reported, consisting mainly of Potsdam sandstone, was found.

The most interesting fact in connection with this well remains to be stated. In the sandstone, which is about 50 feet thick, in the lower half of the interval, a vein of gas was struck. The gas showed considerable force and pressure. Though the well was imperfectly packed, the gage put on it registered a pressure of 340 pounds. This gas seemed to the drillers to differ in several marked particulars from the Trenton gas, with which they had become familiar. It had, as they reported, a different

odor, resembling more that of Pennsylvania gas. It burned with a much redder flame and deposited carbon or lampblack more abundantly. In fact, it seemed particularly rich in this last substance.

In my visit to the well in 1897, it was impossible to verify all these observations. The odor of the gas did not seem to differ in a marked way from that of Pulaski gas, and certainly did not suggest Pennsylvania gas. The redder flame of its burning was, however, recognizable, and with this fact the greater deposition of carbon could readily be seen to agree. It was not found practicable to attach a pressure gage, but the testimony as to the fact of the original figure was direct, and there seemed no reason to call it in question.

After the well had been drilled to its full depth, a small torpedo was exploded in it. It seems that the explosive was lowered a little deeper than it was intended, so that it took effect on the upper part of the granite as well as on the sand rock. The gas flow was somewhat increased and many fragments were broken from the granite. A quantity of granite chips was left lying on the ground where the sand pump was last emptied.

This discovery is one of the most interesting that has recently been recorded in the history of the petroliferous series and has an important bearing on the questions pertaining to the origin of the same.

Here is a considerable volume of gas lying but a few feet above the granite. It must have originated where we find it, for gas can not descend in the geologic scale. The law of gravitation forbids. Neither can it rise in the scale, for the shaly beds that form the roof of the gas rock are impervious. If they had not been the gas with its pressure of 340 pounds to the square inch, which is the same as 48,960 to the square foot, would certainly have risen to some higher level.

There is no indication of temperature above the normal in connection with its formation. A temperature of even 200° F., acting on this series of rocks, with the alkaline liquids with which they are here and there charged, would inevitably have worked important changes in the rocks themselves.

Silica is dissolved under such conditions and must have been reprecipitated in the rock series. Such quartzitic sheets would

be the terror of the driller and could not in any wise escape his notice, but he finds no such hardened material and moreover brings up in the sand pump good sized fragments of all the formations that he traverses and these in every case are entirely normal. The thin sheet of Cambrian limestone that lies just below the gas rock and just above the granite is compact and hard to drill but there is no trace about it of metamorphism by heat.

Precisely the same line of facts comes to view in the deep wells of western Pennsylvania and West Virginia. A well was drilled a few years ago at Titusville to a depth of 3553 feet. It is known as the Jonathan Watson deep well. The lowest stratum that the driller reached was the well known and widespread red Catskill. This stratum is everywhere inherently red, throughout this part of the country, because of the peroxid of iron that it contains. The fact seems to have deceived at least one driller who is quoted by Prof. S. F. Peckham [*Proc. Am. phil. soc.* 1898] as saying: "The soapstone became harder as they went down and was red in color; in fact had been burned like brick." This statement shows complete misunderstanding of the facts and in reality contains a serious misconstruction of them. The Catskill beds are a normal part of every section in the region, but below them there are many hundreds of feet of gray, blue and black shales, retaining their fossils and all their normal characters. The redness of the Catskill is in no wise a sign of metamorphism by heat.

Prof. I. C. White, state geologist of West Virginia, who is our highest authority on all facts in this line, writes as follows: "I have personally inspected the slates in the Wheeling well, 4500 feet deep, and in the West Elizabeth well, 5500 deep, and in the latter, after the red Catskill is passed there are no red beds at all. The slates in this well for the last 3000 feet are dark gray or bluish gray, while in the Wheeling well, from which the red Catskill had disappeared to the westward, there were no red beds whatever below the Barren or Elk river series of the coal measures. The same conclusions and facts have been confirmed by hundreds of other deep borings within my knowledge."

The fact is, the deepest we have ever gone in the rocks of New York and Pennsylvania, the depth in some cases exceeding

one mile, there is no sign of metamorphism, but on the contrary, clear negative proof that the temperature of the series has never been as high as 200° F.

The gas of the Potsdam must have originated in or immediately below the stratum that contained it, but it could not have originated as gas, contemporaneously with the sandstone formation. The Potsdam must have had an impervious cover before the gas could have been developed. If the material had been in the form of oil, the storage could well enough be accounted for. The transformation of oil into gas is a process that we know to be going on in nature and we can be sure that time enough has elapsed in this instance to provide for its completion. That the gas carries so much carbon loosely combined and ready to be deposited as free carbon or lampblack, matches well with this view of its origin.

Is there any possible source of petroleum revealed in this section? The thin streak of Cambrian limestone, with its fragments of the shells of Lingulella and Obolella and its hints of trilobitic crusts shows the presence of life in the seas in which it grew. Living matter, as we have seen, can be easily converted, at least some forms of it, into the petroliferous series by artificial processes. What man finds easy, nature, in her great laboratory is likely to find still easier. It is not necessary to hold that the limestone in its present state has yielded gas by destructive distillation of its substance. Though darkened by organic matter, there is but little in it that even under the process named would be converted into gas, oil or tar. We may be doubly sure that no limestone like the Cambrian which we find here was the source of the gas or of the oil which preceded it. In the first place, there is not organic matter enough, and in the second, there has been no abnormal temperature.

If, in the early stages of its formation, the organic matter, the existence of which is attested by the fragments already referred to, had been converted into oil, either by a peculiar form of decomposition according to Hunt, or by a process of distillation in which "time takes the place of temperature," according to Peckham and others, the presence of petroleum or gas would be satisfactorily accounted for. But it is to be borne in mind that neither of the processes named has been proved to be

in actual operation in the world today. Both are assumptions, pure and simple, supported, however, by more or less facts that require some explanation.

The presence of granite, an igneous rock, just below the gas rock, has no significance whatever as showing the probability of any unusual source of heat. The temperature of the igneous rock must have fallen to the normal temperature of the crust before the sandstone was deposited on it, for the sandstone is a marine formation and its 50 feet of thickness require a considerable term of years for its accumulation on the seashore. There is nothing whatever to indicate that a rock of igneous origin, after it has taken its place in the regular series of surface rocks, is any warmer than an aqueous rock. In fact, we know that there is no difference whatever in this respect.

The gas from the Potsdam sandstone warrants two conclusions that we can not afford to miss, viz, first, the formation of the petroliferous series dates back to Cambrian time; second, it is entirely disconnected with any unusual or abnormal source of heat that could leave a record in the rocks.

A second well was drilled in Parish because of the strong persuasion of the driller that oil must be near. The driller offered to make a new test if the people would raise $600. The amount was forthcoming and a second location was made on the Wilcox farm, six miles e. n. e. of well no. 1, near the line of Antwerp township. This well was carried to 2080 feet. The gas was even feebler than in no. 1. Salt water is now flowing from the well, probably derived from some horizon above the plug. The citizens interested in no. 2 formed a sort of association and leased a large amount of land. This association still holds about 3000 acres. The drilling in Parish cost the people about $1200.

g *Central Square.* This village is in the town of Hastings. It is situated to the south and west of Parish. A deep well was sunk here at the time when the fever of drilling was spreading through the county. Frequent references have been made to it by drillers who were cognizant with all the facts pertaining to it, but Mr J. T. Kilham, who had charge of the work, gives the following record:

Drive pipe	18 ft
Medina sandstone (and Oswego)	862

Bastard rock (Pulaski shale)	549 ft
Black slate (Utica)	180
Trenton limestone, struck at	1609
Potsdam sandstone, struck at	2259
Granite, struck at	2415

The thickness of the Trenton limestone is given in the record as 747 feet. There is a lack of correspondence in the several records extant, but there is probably no error in the depth given for the granite, 2415 feet. The identification of the top of the Trenton limestone may have wavered. It is taken here as 1609 feet.

What was found in the well in the way of geologic interest has already been noticed. The Potsdam sandstone made a great impression on the drillers who were acquainted with the Pennsylvania field. It was a genuine surprise to them to find such a clear and sharp sandstone here, but it would not have been had they been conversant with the scale of New York. They honored the new-found sandstone with many indications of their interest. It was called by them " Virginia sand ", " McDonald sand ", etc.

Potsdam sandstone in this occurrence and in the Parish well and at Greig, Lewis co. has caused considerable trouble and expense in the questions it has raised to the people of this region.

h *Oswego.* Drilling has also been done for the city of Oswego, in its immediate neighborhood, but nothing was found to give encouragement to the prospectors. A well drilled in the valley reports:

Sandstone (Medina and Oswego)	600 ft
Shales (Pulaski and Utica)	597
Trenton limestone, at	1197

This well was entirely unproductive.

Section 2

Jefferson county

A few wells have been drilled in Jefferson county in the search for gas that is here being placed on record, and it seems proper to make a brief note of the fact, though no economic gains can be traced to the explorations here.

a *Adams.* One of the most thorough of these attempts was made at Adams, principally under the control and at the expense

of one man, Mr Rufus P. White. Mr White has expended between $7000 and $8000 and kindly gives to the survey the result of his experience.

It seems that natural gas has long been known in this vicinity. Many years ago a physician of the town, Dr Rosey, found gas escaping from the crevices of a rock bottomed stream. He managed to collect enough gas here to boil water. Later, Mr White discovered a gas spring in the Utica slate and by a little pains collected enough to accomplish the same result, i. e. to boil water. He attracted attention to the discovery by boiling eggs in this way at a picnic party. He came to learn of several springs of this character from most of which sulfureted water, as well as gas, escaped. Then came along the experience of Findlay, O., and of Sandy Creek, nearer home, and he was at last encouraged to apply the drill to the rocks that were themselves holding out so much promise. He brought about the organization of a company under the state laws for this purpose, the nominal capital of which was $10,000. The company obtained a franchise from the village corporation for the purpose of supplying the people with gas for fuel. The stockholders were not all equally enterprising and it came about that Mr White bought out the individual stockholders, one by one, paying to each the amount of his investment, till at last he became sole owner of the franchise. He then proceeded to carry forward the enterprise and went to Bradford, Pa., to purchase drilling tools. While there, an oil operator inquired of him where he was to use the drilling tools. On being told that they were to be taken to Jefferson county, N. Y., the operator took him aside into his private office and informed him that there was only one line in the world on which gas could be found. Bradford was on this line and its direction was northeast. If Adams, Jefferson co., lies northeast of Bradford, there is a possibility of gas discovery there; otherwise not. He then took a map and laid down a rule on it, marking a northeast course from Bradford. To the delight of both, Adams was found directly on the line. Mr White returned, inspired with great confidence. He brought back with him drilling tools for which he had paid $3000, and also four drillers, who were to be paid $4 a day. He entered on the drilling of the first well in April 1891. The drillers found six feet

of soil, drift, etc., and then entered the Trenton limestone directly. At 400 feet gas enough to run the boiler was struck and there were frequent accessions as the drill descended. At 600 feet, a stratum of soft rock called shale by the driller was struck. The well was tubed with one and one fourth inch pipe and packed at 314 feet. The casing was set, as Mr White recalls it, at 450 feet. The gas showed a rock pressure of 120 pounds. The driller struck granite at 915 feet and drilled a day or two in this formation at the rate of 30 to 36 inches a day. The total depth of the well is 921 feet. Mr White piped the gas to his house and also supplied a few of his neighbors. The use was enjoyed for six months or a year, but the supply disappeared suddenly, like a lamp blown out. The gas was undoubtedly drowned out.

It seemed that there was nothing in the experience to discourage Mr White. He took a new location, one mile farther south, took down the derrick used in no. 1, drew the nails and put it up again. He found here 33½ feet of drift, cased the well at 204 feet, struck gas at 350 feet and carried it to the boiler. Part of the drilling was done in this way, but the gas did not hold out to the end of the work. This well was packed at 267 feet and was tubed with two inch pipe. It was finished in the granite at 950 feet. A vein of salt water was struck at 400 feet, but was soon exhausted. Well no. 3 was located one half mile due north of no. 2. Drilling was begun in August 1891, but only an insignificant amount of gas was found here, much like that in the first well. This well reached the granite at 960 feet and at this point a strong flow of brine, very strong with salt and also very bitter, was released. It could not be controlled by bailing. It filled the casing and overflowed from the well mouth. Crevices are reported as found at times in the limestone so that the tools would drop a few inches. This well was packed at 360 feet, tubed with one and one half inch pipe, but nothing came of it. The different beds of rock changed from harder to softer, but if there are any sandstone beds between the Trenton limestone and the granite, they were not recognized or reported. Mr White has a large part of the original outfit left on his hands.

Small escapes of gas from the rocks are common in this region. Gas is also often struck in water wells, but no large stock has

ever been reached. A test of the field was necessary to satisfy the minds of the people, but farther tests are not required.

b *Watertown.* A company was formed in Watertown to test the territory with reference to gas and several wells were drilled in this interest on the south side of the town, but unfortunately authoritative and exact records of the work are not now obtainable. One of the wells drilled near Remington's paper mill is said to be 400 feet deep. A more circumstantial, but perhaps not more reliable, account gives 573 feet for its total depth. This report is to the effect that granite was reached at 140 feet and that the drill was kept at work in it till 433 feet were added to the depth of the well. It is certain that granite was found in some of the wells.

The valley of the Black river runs through Watertown and gives one of the finest natural sections of the Trenton limestone to be found in the state. It is scarcely inferior to the famous and typical section found at Trenton Falls. The several divisions of the Trenton are all recognizable in the gorge and some of the finest fossils of the state are credited to this locality. As to the interval between the Trenton and the granite, no data have been obtained. It is probable, however, that the Potsdam sandstone holds its place in this series.

Neither gas, oil nor water was found in the series penetrated by the drill, but in portions of the county the water obtained from shallow wells in the limestone is notably saline, and the saline water is in many cases also sulfurous.

At Rodman a well was drilled at about the same time as the Watertown wells, in which the granite is said to have been reached at 900 feet.

There is a possibility of small accumulations of gas in the southeastern section of the county, where the Lorraine shale covers the entire Trenton series. Conditions similar to those that are found in Sandy Creek, for example, occur here.

Section 3

Onondaga county

a *Baldwinsville.* By far the largest production of gas from the Trenton limestone thus far found in the state has been developed in Onondaga county. The village of Baldwinsville, which is the

center of this production, has a good deal of enterprise and business activity and has availed itself of the fine water power supplied by the clear and steady flow of the Seneca river, the outlet of the Finger lakes.

It could not be otherwise than that the experience of the villages near by, specially of Fulton and Pulaski, should inspire Baldwinsville to set the drill at work to ascertain its possibilities in respect to the new fuel. Fulton is but 12 miles distant.

A company was organized under the name of the Baldwinsville light and heat co. and drilling was begun in the late fall of 1896. Of this company J. T. Wilkins is secretary and treasurer and in fact has had the principal direction and control throughout its history thus far.

The first well of this company was located a little northeast of the village center on the Monroe farm. It found the Trenton limestone at 2250 feet and was drilled into this formation 120 feet, making its total depth 2370 feet. A good vein of gas was struck at this depth, the rock pressure of which was 1200 pounds. The driller was not prepared to control the well when gas was struck and it was left to blow wide open for 12 days, during which time the gas escaped to the amount of at least 1,000,000 feet a day. On the 13th day the well was tubed with three inch pipe and shut in and its utilization was immediately begun. Gas was furnished to consumers through meters from the first.

The section of the strata shown by the well is normal in every particular. Below the drift the Medina sandstone and shale are struck. The upper part of the sandstone is white, the lower red. Below the Medina the Oswego sandstone, bluish gray in color, comes in, and, in due order, the Pulaski shale. From the last named formation the Utica shale is distinctly separable, the boundary being perfectly defined. The boundary of the Trenton limestone below the Utica is also, in most cases, distinctly recognizable. A later well has been drilled into it 500 or 600 feet, but thus far no drilling has been carried to the underlying granite, which will be found at a depth of about 3000 feet.

In the Monroe well gas was found all the way down, in the Medina and Oswego sandstones and in the Utica shale, but the great volume came from the Trenton limestone. Warned by the unfortunate experience of Fulton, the Baldwinsville company did

not take on all the consumers of gas that it could have secured, but from the first determined to husband its resources and not to press its gas supply to the limit. For the first four months of the service the Monroe well was drawn on for 2,000,000 feet a month, or 66,666 feet a day, and this moderate use was marked by a notable decline in the pressure of the well. In March 1897, the pressure was 800 pounds. It declined rapidly thereafter and brought alarm to those cognizant with the facts, but by this time the second well had been carried well down into the Utica shale and was furnishing a considerable volume of gas. This supply was at once turned into the city line and presently the Monroe well was cleaned out and drilled a few feet deeper. 50 feet of shale, dropping from higher levels, had accumulated at the bottom of the well. This was removed and the driller set to work for a few feet on rock never reached before. According to some reports it was deepened 50 feet, which would make its total depth somewhat more than 2400 feet. Its volume was not only restored but increased and its pressure rose to a much higher figure than ever before, viz, to 1540 pounds. After allowing the well to blow for 24 hours, with interruptions, 1450 pounds was registered. The gas in July 1897, when observation was taken for the survey, showed a pressure of 1350 pounds. When returned to the line a decline of 45 to 60 pounds to the month was again experienced, while the gas consumed did not exceed 1,000,000 feet for the same length of time.

Well no. 2 was drilled in the river valley on the Wells farm and is known as the Wells well. The drill began work on it early in 1897. A good volume of gas was found in the Medina, reported at 400,000 feet a day, but at 1838 feet, in the Utica shale, the production became so large that it was impracticable to keep the tools at work. The well was tubed with three inch pipe at this depth and an open pressure of 2.75 inches of mercury was shown. This stands for a daily output of 2,126,270 cubic feet. The rock pressure at this time was 825 pounds, which was reached in 17 minutes after the gate was shut. As stated in the preceding paragraph the entire village plant (160 meters) was put on this well for a period of three months, and in this time the pressure was not reduced below 500 pounds. The tubing was set at 600 feet. This well has since been drilled into the

Trenton limestone and the experience has been very troublesome and costly because of "blowers" of gas that were once and again encountered in the descent of the drill.

Well no. 3, known as the Dow well, is located one half mile west of no. 2. At the time of my examination it had not been drilled to the Trenton. It found a strong gas vein in the Medina sandstone at 925 feet, which was not tubed and which was allowed to burn from the casing for a number of weeks. It furnished several tens of thousands of feet a day.

The records of two of the wells will here be given in somewhat more detail. The facts were furnished by John T. Kilham, an experienced operator from Pennsylvania, who entered this field in 1894 and has kept close and intelligent watch of every feature in the development thus far. The survey is under great obligation to Mr Kilham.

	Monroe (no. 1)	Wells (no. 2)
Drive pipe	38 ft	43 ft
Cased	348	250
White Medina	542	....
Red Medina	620	585
Oswego sandstone	1200	1223
Top of Trenton	2240	....
Packed	1350	618
Rock pressure	1375 lb.	825 lb.
Gas for boiler	1714 ft	639 ft

The management of the company has been conservative and wise from the first. It has sold gas by meter only and has refused to put on consumers beyond its ability to furnish an adequate supply. In consequence its service has been thoroughly satisfactory to its patrons, and the business promises fair financial returns to the stockholders.

From November 1896 to August 1897 the company supplied about 14,000,000 cubic feet of gas, all of it being furnished by wells no. 1 and 2 and mainly by the former.

The next step in the development of the field was taken by the firm of Pierce, Butler & Pierce, an enterprising and successful business house of Syracuse. This company is interested in a steam heating plant in the city and also obtained from the

city government a franchise for the use of the streets for piping natural gas.

It began operations in September 1896, under the name of the Onondaga gas co. Its first work was purchasing the leases of a considerable territory which had been taken up by Mr J. T. Kilham. Mr Kilham conveyed to the firm drilling rights on 5000 acres of land lying mainly to the south and southwest of Baldwinsville. A contract was at once entered into with the drilling firm of Stearns & Leopold to sink two wells. Drilling was begun at once. Well no. 1 was located on the Names farm, one half mile south of the Baldwinsville railroad station in the valley of the Seneca and on the north side of the river. There was nothing irregular or exceptional in the record of the well. The drift was shallow (20 feet) at the point where the well was located. The Trenton was reached at a depth of 2270 feet and at 2368 feet the first gas was struck. Drilling was continued to 2547 feet, the well being finished in November. It was tubed with three inch pipe and was packed at 1400 feet but was afterwards repacked at 630 feet. A little salt water was struck in the Oswego sandstone at 1210 feet. The rock pressure when the well was first shut in, was 1460 pounds, and the open pressure was 1.5 inches of mercury, indicating a flow of about 1,500,000 cubic feet a day. Later the well filled with water to a considerable depth. It had not been put into use when the field was visited in the interests of the survey.

Other items in the record of this well are the following: cased, 318 feet; white Medina (with gas), 600 feet; Oswego sandstone, 1285 feet; Pulaski shale, 1765 feet; Utica shale, 1878 feet. The Salina shale, 138 feet thick and 45 feet of Niagara limestone came in near the beginning.

Well no. 2 of the Onondaga company was drilled on the Van Ness farm, three miles southeast of no. 1. This well reached the Trenton at 2280 feet and was subsequently drilled to a depth of 3035 feet, but the stratum proved entirely destitute of gas. The only useful purpose the well could be said to serve was in proving territory. It has discouraged drilling to the east of Baldwinsville.

The next well to be drilled in the field was undertaken by a new interest, namely, the Trenton-rock oil & gas co. The princi-

pal interest in this company belongs to the Rose brothers. A well was located on the Waffle farm, about two miles directly west of the village. It found the Trenton limestone at 2248 feet and was drilled to a depth of 2860 feet. It was packed at 480 feet and showed a rock pressure of 450 pounds. Its volume was small, not exceeding 200,000 feet a day. This well was "shot" with 110 quarts of nitro-glycerin, but without bringing any improvement. No use had been made of its gas up to the autumn of 1897.

During the summer of 1897 the Onondaga gas co. put down four wells, two located on the Talmage farm, about two miles south of the village, and two on the Spaulding farm, about four miles south of the village. The reduced record of Talmage no. 1 is given herewith. Gas was first found in the White Medina at 776 feet. The Oswego sandstone was struck at 1200 feet. The well was finished at 2020 feet. A fair volume of gas was found in the Trenton limestone, the rock pressure of which was 545 pounds when first struck, and 560 pounds in August 1897, when measured for the survey. The open pressure in the three inch tubing indicated a total output of 1,000,000 feet a day. The well was packed at 625 feet.

Early in August 1897, the Spaulding well no. 2 was drilled to the Trenton limestone, which it reached at 2404 feet. At 100 feet in this stratum gas enough to fire the boiler was obtained. Of the fortunes of Talmage no. 2 and Spaulding no. 1, record has not been obtained, but if they had achieved any marked success the facts would not have escaped observation.

The Binning well, so called, located on the Hickok farm, was the first venture of a new company in the field, viz, the Phoenix natural gas co., composed in part of experienced operators who had already taken part in the development of Baldwinsville gas. This well is located one fourth of a mile east of no. 1. It was completed in July 1897.

The Binning well was the seventh successful well of the Baldwinsville field, and being much larger than any of its predecessors, it attracted great attention and made a marked impression on the public mind. It was widely noticed in the newspapers of the day, mostly by reporters who had never seen a gas well except in this particular region, and who, finding this well much

larger than the wells that surrounded it, passed hurriedly to the conclusion that it was the greatest gas well ever found in the world.

The phenomena of a large gas well when first opened and before it has been brought under control are certainly impressive and newspaper reporters may well be pardoned for exaggeration in describing them. Strong words and vivid description are needed to convey to others the impression by which those on the scene are overpowered.

In reality the Binning well does not take a high rank among gas wells, so far as volume is concerned. It is credited with 3,122,000 cubic feet a day from a three inch pipe. In other words it is a respectable, but not a great well. To warrant its being included in the latter class its volume would need to be multiplied at least threefold.

Its rock pressure when first measured was, however, clearly of the first order. The gage recorded 1135 pounds and in August, when measured for the survey it had risen to 1180 pounds. It never reached the amazing figure reported for well no. 1, viz, 1540 pounds, the highest figure yet published from any gas well of the country. It will be remembered that this well, when measured in August 1897, showed a pressure of 1360 pounds. After the drilling of the Binning well the pressure of the Monroe well began to decline slowly, while the gage showed an increase in the pressure of the former. To those conversant with the facts it looked as if the wells were in some way in underground communication, and as if equalization of pressure would ultimately result. The longer experience to the present date will settle all questions of this kind.

The next successful attempt to reach the Trenton limestone was made by the Empire Portland cement co., near its works at Warners, on the New York central railroad, about six miles due south of Baldwinsville. This well reached the Trenton at 2696 feet, but the tools got fast soon afterward and several months were spent in freeing them. The well was finally completed in September 1897, a depth of 3526 feet having been reached. A small volume of gas was obtained but not enough, in itself considered, to justify the amount expended in sinking the well. The abbreviated record of this well and a second well, located one

mile west of the first is as follows: Drive pipe (no. 1) 160 feet; Medina sandstone, 1050 to 1850 feet; Trenton limestone, 2700 feet; Potsdam sandstone, 3500 feet.

The most interesting fact remains to be stated. While in no. 2 a small amount of gas was furnished by the Medina and the Trenton formations, the only important vein was found in the Potsdam sandstone. Gas was struck at 3526 feet. The amount was sufficient to run the boilers of two 125 horse-power engines for six or eight weeks. At the end of this time the volume fell away till there was barely enough gas for one boiler. The initial yield must have exceeded 100,000 cubic feet a day. The original rock pressure is said to have been 800 pounds. The granite has not been reached in either well, but it does not lie far below the bottom of no. 2, viz, 3600 feet. A third well has been located one mile west of no. 2 and two miles west of no. 1.

In November of the same year another well of great force was struck on the Kendall farm in the same district with the Monroe and Binning wells. It was drilled by the Onondaga gas co., which was also known as the Syracuse steam heating and power co. The rock pressure of this well was reported at about 1100 pounds. The Trenton limestone was reached at 2250 feet. At 2350 feet, or about 100 feet below the surface of the stratum, a gas vein of unusual force was reached. It drove the drilling tools and cable out of the well, throwing the drill high above the derrick. The cable alone weighed over 4000 pounds. It is certainly remarkable that more than 2000 feet of it should be lifted bodily and made to clear the hole, without binding anywhere. The well was "bridged" by fragments falling from above after the tools were blown out.

A well known as the Toll well was drilled still later in the same neighborhood and its character was in keeping with the wells that preceded it. These four wells, the Monroe, Binning, Kendall and Toll wells, mark the center and highest development of what may be called the Baldwinsville gas field.

The Onondaga gas co. laid a pipe line in 1897 from the Baldwinsville field to its works in Syracuse. Part of the line is six inches in diameter. One of the wells, Talmage no. 1, was attached to the line, and was used for a time in the steam heating plant at Syracuse, but a notable fall in the rock pressure is said

to have followed the consumption of a few hundred thousand cubic feet of gas a day.

It is commonly reported that this company has recently sold its entire plant, leases, wells, pipe-lines and franchises to the Syracuse gas light co. but the fact or the terms of the sale have not been made public. The use to be made of the gas will soon be determined, but it is probable that some of it will be introduced into the city gas line, to be intermixed with the artificial product.

During the past year the number of wells in and around Baldwinsville has been more than doubled, but no new features have been added to the field. Those who have drilled the later wells have kept well within the boundaries already established as covering productive territory, so that no additions to the latter have been made.

The most notable fact of the past year is the deepening of the Monroe well by the addition of 240 feet to its depth and a consequent great addition to its volume and restoration of its rock pressure, which had been lowered more than 1000 pounds. The Baldwinsville wells were greatly reduced by the winter demand, and if the month of March had not been unusually mild a shortage of gas would have been experienced in the village supply. After deepening, the well showed a rock pressure of 1350 pounds, which was gained in 15 minutes. Its volume, as measured by the open flow, was 3,737,000 cubic feet a day. This is the largest volume yet reported from any well in this part of the state.

The specific gravity of the Trenton limestone gas from the Baldwinsville field, and, no doubt, representing the gas of all the fields, was determined for the survey by Mr W. W. Randolph of New York, who is expert in this line of investigation. He made use of the "effusion method," employing modern apparatus of the most approved construction. The results of a number of observations showed the figure .551 to represent the specific gravity of the gas, but even this figure was held subject to correction.

The composition of the gas was determined by the Syracuse gas co., the analysis being conducted by Dr Durand Woodman of New York. The gas company kindly allowed the survey the use of its results, which are given below:

Composition of Baldwinsville gas

Acetylene	.00
Hydrogen (by the palladium method)	trace
Marsh gas	98.40
Carbon monoxid	.95
Carbon dioxid	.00
Illuminants, diffused	.25
Oxygen	trace
Nitrogen, by difference	.40
	100.00

Specific gravity, by calculation, .558

Heat units a cubic foot, 1013.5

Odor faint, resembling crude Pennsylvania petroleum.

These figures may be taken with all confidence as representing the composition and specific gravity of the Trenton limestone gas of New York.

In 1886-87 Prof. C. C. Howard of Columbus, O., made a number of analyses of the gas from the new fields of Ohio and Indiana and reported 92% to 94% of marsh gas, but also reported about 3% of nitrogen, 2% of hydrogen, together with a small amount of carbon dioxid. Prof. Howard afterward found reason to suspect that these latter figures were the result of erroneous methods of analysis, but did not have opportunity to repeat his work and eliminate the doubtful points. He also calculated on the same basis the specific gravity of Findlay gas and made it .566. If the corrections suggested should be found necessary, they would, when made, bring the composition and gravity of the Ohio gas to agree closely with Dr Woodman's figures for the gas of New York from the same stratum.

The only important difference between the production of the two fields would be found in the sulfur contents of the Findlay gas. This element does not occur in the gas of New York from the Trenton horizon. In Ohio and Indiana the sulfureted hydrogen of the gas is very noticeable and offensive. According to Prof. Howard the sulfur of this compound amounts to 1.25 grains to the cubic foot of Findlay gas.

The presence of the sulfureted hydrogen is not an unmixed disadvantage to the gas. By its odor it gives prompt warning of leaks in the lines of supply, and does a good deal to protect the users against danger from this source.

It would seem as if its presence is to be ascribed to the sulfureted water which is found in contact with the gas in many parts of the field. The Kingsville gas field of Ontario furnishes gas from an entirely distinct horizon, but under conditions similar to those found in Findlay and its gas has the same composition in all respects, including the sulfur contents.

The danger in the handling of the gas of the western fields lies in this fact, i. e. that the plumbing in many towns is so poorly done that the air is constantly loaded with the odor of the leaking gas, so that even dangerous leaks may escape observation. Careful and thorough work in plumbing should be insisted on in every town and in fact in every house in which gas is introduced.

It must be added, however, that no serious accident from explosions in connection with the recent discovery of gas has thus far been recorded in this state.

Is Baldwinsville gas shale gas?

To refer Baldwinsville gas, with its wells of large volume and of extremely high rock pressure, to the somewhat inferior division of *shale gas* as contrasted with *reservoir gas*, seems at first sight invidious and unjust, but the insignificant gas-flows from the rocks of Jefferson county, already described, where the Trenton limestone occurs in outcrop, admit of no other reference. They agree in all particulars with the small wells derived from shale formations of typical occurrence. But the gas at Sandy Creek and Pulaski clearly belongs to the same division as the gas of Jefferson county, being found in unmistakably the same horizon and having the same general characters. These characters can be stated as follows: 1) No two wells draw their supplies from exactly the same horizon, but the gas is frequently distributed through one or two hundred feet of the strata, the total flow being made up of numerous small veins. It is true, however, that gas is looked for more confidently at one particular range than another. 2) No two wells have the same rock pressure. The records of the Pulaski field, for example, have shown from

the first the considerable range of 165 to 650 pounds. A difference of several hundred pounds can sometimes be noted between two closely contiguous wells. 3) Salt water is not found in any considerable quantity in any of the wells and is entirely absent from most records, even of wells that are drilled to the granite. 4) No portion of the series from which the gas is derived shows porosity. There is nothing in its composition to indicate this quality. The Trenton limestone of New York makes no approach to its dolomitic phase, so far as the examination has thus far gone. Samples of the formation were taken for chemical analysis from various localities and particularly from representative points as Trenton Falls for the sake of comparison with the drillings of deep wells and as a possible aid in identification of the various elements of the sections traversed by the drill. The results did not meet anticipations but they are given below. The analyses were executed by Prof. Edward Orton jr, of Columbus, O.

Analyses of limestones of Trenton age

No. 1 Birdseye limestone from 10 ft ledge two miles below Poland, in bank of Canada creek.

No. 2 Average of 12 ft "velvet blue" rock at foot of stairway, Trenton Falls.

No. 3 Average of 20 ft uppermost section of Trenton limestone at Prospect.

No. 4 Drillings from upper beds of Trenton from well no. 2, Rome, 680 ft below surface.

	1	2	3	4
Silicious residue	5.14	5.63	1.52	8.16
Alumina and iron oxid	1.59	1.40	1.39	1.87
Calcium carbonate	91.11	90.56	95.56	86.03
Magnesium carbonate	2.18	2.45	1.81	3.49
Total	100.02	100.04	100.28	99.55

Analyses of Utica shale

No. 1 Lenticular mass of limestone in shale, Waterman's hill, near Poland.

No. 2 Average of 36 ft lowermost beds of shale, Waterman's hill, near Poland.

No. 3 Drillings from well no. 2, Rome, 350 feet below the surface.

1

Silicious residue	16.00
Alumina and iron oxid	3.30
Calcium carbonate	74.17
Magnesium carbonate	5.26
Organic matter, by difference	1.27
Total	100.00

2

	Total ultimate analysis	Analysis of that portion insoluble in H_2SO_4 & Na_2O_3
Silica	34.94	21.62
Alumina	10.77	.67
Ferric oxid	2.07	
Lime carbonate	43.80	.14
Magnesium carbonate	4.22	.16
Potash	2.15	1.06
Soda	1.91	
Combined water	0.47	
Manganese	trace	
Total	100.33	23.65

3

	Total ultimate analysis	Analysis of that portion insoluble in H_2SO_4 & Na_2CO_3
Silica	51.89	30.36
Alumina	18.84	.98
Ferric oxid	3.27	
Lime carbonate	7.41	.20
Magnesium carbonate	2.87	.28
Potash	2.80	.89
Soda	2.53	
Loss on ignition, CO_2, H_2O	10.39 (by difference)	
Manganese	trace	
Total	100.00	32.71

The most productive portion of the Trenton, in the judgment of drillers who have done the most work in the new fields, is the highly fossiliferous beds. Mr C. W. Vroman, for example,

felt quite encouraged in his Stillwater well, already described, when chips were brought up showing the presence of abundant fossils. These chips agreed perfectly in appearance with fragments of the *Orthis testudinaria* beds from Trenton Falls and other well known horizons of the limestone.

On grounds like these it seems necessary to class the Baldwinsville gas fields with the Pulaski and Sandy Creek fields. The gas lies much deeper and there is a much larger production, but it is essentially of the same character. The difference between the two varieties has already been pointed out on the preceding page, but in respect both to volume and rock pressure the Baldwinsville wells are far in advance of all the rest that are referred to the same division. A few hundred thousand feet of gas a day and a few hundred pounds of rock pressure make the record of the largest shale gas wells hitherto observed and recorded.

In regard to this last element, viz, rock pressure, the facts of the Baldwinsville field oblige us to extend the explanation that has thus far been counted sufficient for shale gas wells far beyond the limits heretofore recognized. The pressure in shale gas fields has long been counted due to the expansive force of the gas as it is generated. No other force adequate to the production of the result has been discovered.

The case is entirely different in the matter of reservoir gas, i. e. of gas stored in porous rocks that are also occupied by other fluids. The facts derived from the new fields of Ohio and Indiana brought to light another cause at once true, real and efficient, that gave a rational and intelligible explanation of all the phenomena involved.

It was observed that when salt water was struck in the Trenton dolomite it rose throughout the field to a fairly uniform hight of 600 feet above tide. Its ascent was obviously referable to artesian pressure. No other explanation is worth a moment's consideration. But the artesian pressure that forces water to rise in the porous rocks, would exert an equal pressure on any other fluid, as oil or gas, inclosed in the same porous rock. It was farther found that by taking account of the specific gravity of the salt water, the pressure, which is apparently due to 600 feet of the water, could be measured in pounds. The weight of

the column was found to be equal to 286 pounds to the square inch, the specific gravity of the brine being about 1.1.

At Muncie, Ind., the gas rock was found to be at tide level. The gas ought, therefore, to show a pressure of 286 pounds, if this explanation is correct. The testimony of experienced oil operators who observed the facts at the time the first wells were drilled was to the effect that the rock pressure was between 280 and 300 pounds. It is to be noted that only when the first wells of a field are drilled can the facts as to the original rock pressure be accurately found. New adjustments of the contents of the porous rocks become necessary when the equilibrium is once interfered with, and a great many circumstances come in to affect the rock pressure when drilling in a field has once got fairly under way. In default of exact information, therefore, it is safe to say that in this case the correspondence between the observed facts and the theoretic calculation of what the rock pressure should be is sufficiently close.

In Marion, Ind., the gas rock was found at a depth of 78 feet below tide. To the 286 pounds of pressure due at tide level there must be added the weight of the 78 feet of salt water below the level named. The amount of the true pressure was 323 pounds. Visiting the field when the first well was completed I found that the gage read 323 pounds. This fact was recorded before any theory whatever had been formed in regard to the cause of the rock pressure of gas.

A well at St Henry, in Darke co., O., found the gas at 200 feet below tide. After being allowed to blow into the air for three months its pressure was found to be 375 pounds. The 800 feet of salt water found here would exert a pressure of 385 pounds. It seems altogether probable that at least 10 pounds of pressure were lost in the three months of unrestricted flow.

In well no. 1, Upper Sandusky, gas was struck at 470 feet below tide, which would necessitate a rock pressure measured by a column of salt water of 1075 feet in hight. This would make the theoretic rock pressure of the gas 513 pounds. The actual pressure as reported by Dr A. Bilhardt, a careful and conscientious observer, was 515 pounds. Finally, at Tiffin, in the Loomis and Nyman well, gas was found at a depth of 747 feet below tide. The salt water column on the gas must

then have been 1347 feet, which equals 641 pounds. The gage by which the pressure was tested was graduated only to 600 pounds, but the index traveled beyond this point and the figure at the time was reported as 650 pounds. These facts may be stated in tabular form.

LOCATION	Depth to gas	Depth below sea level	Theoretic pressure	Observed pressure
Muncie, Ind	900 ft	0 ft	286 lb.	280–300 lb.
Marion, Ind	870	78	323	323
St Henry, O	1156	200	385	375
Upper Sandusky, O...	1280	478	513	515
Tiffin, O............	1500	747	641	650

These are the best examples found that bear on this point, but the mind must be peculiarly constituted that can consider these facts as accidents.

The Kingsville gas field of Ontario is another case in point. It finds its supply in a very pure and porous dolomite of Silurian (Upper Silurian) age, and the pressure of all the wells drilled, 30 or more in number, is approximately the same, viz, 400 pounds. Where the gas is withdrawn by a pipe line, the pressure falls equally in all contiguous wells, whether connected with the line or not. The hight to which the salt water rises has not been fully determined as yet, but the highest pressure noted, namely 415 pounds, would show a water column of 850 feet, if the specific gravity of the salt water found proves to be the same as that in the porous Trenton of Ohio. As the wells are drilled about 1025 feet to the gas vein and as the elevation of the surface is approximately 600 feet above tide, the salt water should be found to rise to within 175 feet of the surface. If this is hereafter found to be the case, it will complete the demonstration in the most conclusive manner. It is to be noted that observations will be valid only in wells that are cased below 500 feet, as a fresh water vein of great force is reached at about this depth.

There are two distinct forces, then, that take part in the rock pressure of natural gas, viz, its expansive power, and the weight of the salt water column that compresses it. The first cause may exceed the second, and in such cases it would completely mask the latter. Where no porous rocks are found and where a water column is therefore wanting, we are obliged to rely altogether on

the expansive power of the gas. There is a certain unexplained relation between the rock pressure and the depth at which the gas is found. To the understanding of this relation we may confidently expect to attain, as intelligent exploration goes forward.

The conclusions, then, in regard to the rock pressure of gas are as follows: First, there is a pressure arising from the expansive power of the gas itself, and this, so far as observation is concerned, reaches its highest mark in the Monroe well at Baldwinsville, namely, 1540 pounds to the square inch at a depth of 2370 feet. Second, when the stratum that holds the gas is porous and continuous, it must contain water, fresh or salt, in some portion of its extent. Whenever this water shows itself under artesian pressure it must of necessity exert on the oil or gas with which it is in contact the same force that causes the water itself to rise. The rock pressure of the gas can then be measured by the weight of the salt water column. Enough observations are on record to establish this deduction on a solid foundation. But it is possible that the expansive power of the gas may exceed the pressure which the water column would put on it. In this case this element will escape observation altogether. This explanation of rock pressure imperiously requires certain conditions, viz, a continuous porous stratum rising somewhere to day and thus acquiring artesian pressure.

In the development of the Baldwinsville field no theory found place in the location of the earliest wells. Convenience alone was consulted as to where they should be placed. The northeast line, which is based on sound geologic observation in Pennsylvania and western New York, but which is generally a delusion and superstition when applied to other territory, was introduced by the drillers after gas was discovered. An amusing instance occurred in connection with its application to the location of the Binning well.

It is important to the contractor who drills a well to find gas as soon as possible for the boiler that supplies the drilling power. The first gas to be found in any of these wells is in the white Medina sandstone. The Talmage well, no. 1, found gas enough for this service in the horizon named. The Wells well had also the same good fortune. The contractor who was to drill the

Binning well had the same object in view, and for his own guidance drew a line through the two wells named, extending it to the farm on which the new well was to be sunk. A location on the farm had already been selected, but when the contractor came on the ground he changed the location by about 400 feet, to bring it to the line above described and spoke rather vaguely of the importance of the exact location, but without giving his reason for the same. Now it turned out that the Binning well found no gas whatever in the Medina but obtained a much larger flow from the Trenton than any of the wells that preceded it. The interest of the contractor in a particular location and the exceptional volume of the well were put together by those partially conversant with the facts and the success of the well was credited to the exceptional prescience of the contractor, while in reality he had completely failed in the object for which the northeast line had been invoked.

Of course where the accumulation of gas depends largely on the structure of the strata, as has been urged in a preceding part of this report, lines will be found in such fields indicating the higher portions of the rock that contain the gas. Such lines might bear northeast and southwest, but there is no more reason why they should take this particular direction than any other.

The most important structural lines in the new oil fields of Ohio are north and south lines, or, in some instances, lines running a few points west of north. In the Rocky mountains the main lines of uplift are northwest and southeast, while several of the European axes are practically east and west lines.

Section 4

Oneida county

A considerable amount of drilling has been done in Oneida county within the last few years. Deep wells have been sunk at Utica, New York Mills, Rome, and in various other localities. At the two localities first named, the avowed object was not to search for gas or oil. Water was more distinctly in the minds of several of the projectors of these expensive explorations. The drilling has been carried on in several instances by manufacturing companies and in their work they have not seemed to count the cost very carefully. The drill has several times been

sunk for hundreds of feet into granite, where porous rocks are not known to exist and where no encouragement whatever is found in the results of experience. In but one of the towns named, Rome, has there been a definite search for gas and intelligent prosecution of the work.

a *Utica.* In 1896 the Globe woolen works drilled a well in the search for water to a depth of over 1800 feet. Mr P. H. Foley of Utica was the contractor and he has furnished the following record, his nomenclature being somewhat modified.

Drive pipe	48 ft
Utica shale	447
Trenton limestone	369
Potsdam sandstone	440
Granite	551
Total	1855

A gas vein was struck at 225 feet of force sufficient to throw the water from the casing and to make quite an imposing blaze. The pressure of the gas was estimated at more than 200 pounds to the square inch, but the vein was finally cased out of the well and drilling went forward. The contractor divided the great limestone series into two divisions, the upper one being styled a "fossiliferous limestone," but the geologist can not recognize the grounds of this division. Both are unmistakably Trenton. The distance from the top of the Trenton to the granite is normal for this region. Through several counties the measure is about 800 feet.

The experience of this well shows that Utica has enough evidence of gas to justify farther exploration, if her citizens come to attach as great value to this volatile fuel as many of their neighbors do.

The Standard harvester co. also sunk a deep well in 1897, the record of which is as follows:

Drive pipe	65 ft
Utica slate	497
Trenton limestone	368
Potsdam sandstone	4
Total depth	934

A considerable vein of gas was struck in this well at about the same horizon as the gas in the preceding well.

Several other wells have been drilled within the city limits, in all of which weak veins of gas have been found in the Utica shale or in the underlying limestone.

b *New York Mills*. In this manufacturing village, three miles west of Utica, a deep well was drilled a year or two since by Mr Campbell, in an unsuccessful search for water. The record is in some respects a surprising one. Granite was struck at 1000 feet and the drill worked its way slowly down into these stubborn foundations for 1100 feet. This is the deepest boring in granite which the records of this country afford. So far as our knowledge goes, there was nothing whatever to justify such an expenditure.

The records of the Campbell well do not seem to have been so kept as to furnish any facts of scientific interest and there is no economic interest apparent in any of the history.

c *Rome*. A resolute and intelligent search for natural gas was begun in Rome in 1896–97, and has advanced till a number of important facts have been brought to light. The distinct search for gas was preceded by the drilling of a deep well, primarily for water. The successful experience of Utica in the way of obtaining artesian water inspired a like attempt in Rome.

In 1896 a number of the more enterprising and public spirited men of the town effected a loose organization among themselves known as the Factory building co. The object of the association is expressed in the name it took. It set before itself the distinct purpose of introducing and supporting manufacturing enterprises. In this interest it bought 18 to 20 acres of land on the east side of the town and established works for the manufacture of tea-kettles. To farther aid this enterprise, the company proceeded to drill a well on the ground of the new works for the particular purpose above named. A contract was entered into with Rusk & Co. of Ithaca to supply an artesian well. The contract covered a descent of only 300 feet.

The well head is 425 feet above tide. Work was begun in October 1896. The driller found 115 feet of drift; this fact revealing old conditions in the valley of the Mohawk very different from those prevailing there now. The composition of the drift

was as follows: soil, 3 feet; sand, 16 feet; blue clay, 20 feet; black sand, 25 feet; blue clay, 20 feet; conglomerate gravel, 31 feet. The gravel was full of water. At 116 feet the black Utica shale was struck and at 216 feet a small vein of gas was found.

The discovery of gas, even in this small supply, changed the whole situation in the minds of the company. One of the most active and influential members of the organization had seen a little something of natural gas in the regions to the northward already described and he now proposed that the driller should go forward and develop the possibilities of this location in this regard. The Trenton limestone was reached at 630 feet. A second vein of gas, stronger than the first, was struck at 690 feet, and another considerable addition was made at 832 feet. The last vein was in fact decidedly the strongest of the three.

Drilling was continued to 1005 feet but without any other notable accessions of gas.

The well was cased at a little over 200 feet, but the work was imperfectly done, some leakage continuing. A light vein of salt water came with the last supply of gas and made more or less trouble in the pipe.

The use of the gas was however at once entered on. The rock pressure was found to be between 80 and 100 pounds. There was not enough gas to supply the boiler of the works, but all that there was was turned to good account at once in this way. A meter showed that the amount used ranged from 142,570 cubic feet a week in March to 51,490 cubic feet a week in June. At this time the well was retubed with some advantage to its production.

This discovery led to a more definite and thorough search for gas in Rome. A second well was at once projected and work was begun on it early in the succeeding year. This well was located on the grounds of the Brass and copper manufacturing co., which is the most successful and important industry of the town. The works are centrally situated in the town.

The record of well no. 2 as made out by Mr J. G. Bissell is in brief as follows:

Drive pipe	126 ft
Utica slate	509

Trenton limestone, struck at 635 ft	500 ft
Calciferous sandstone, struck at	1135
Granite, struck at	1560

Two veins of salt water, one at 1135 and a stronger one at 1175 feet, were discovered in the descent. The Potsdam sandstone began, according to the determination of the drillers at 1290 feet.

A full set of samples of the drillings was kept by Dr W. S. Kingsley, one of the principal stockholders of the Brass and copper co. as well as of the Factory building co. Dr Kingsley kindly allowed me the full use of these samples and the careful examination of them gives warrant for the following section.

Drift, 125 feet	Soil and clay	16 ft
	Dark, fine grained clay	34
	Dark, gravelly clay	16
	Dark and coarse gravel	29
	Finer gravel	12
	Fragments of Utica shale	10
	Coarse gravel	8
Utica shale, 500 feet	Upper beds at	126
	Very dark shale	350–450
	Hard shale	550–630
	Calcareous shale at	658
	White flakes of lime, approaching Trenton limestone	
Trenton limestone, 435 feet	Upper beds at	660
	Pepper and salt rock (gas found here) at	680
	Light blue limestone at	715
	Light gray limestone	735–765
	Dark blue limestone, hard, at	855
	Limestone, alternately gray and blue	875–925
	Limestone, alternately gray and black	925–1000
	Limestone, black and hard	1020–1025
	Limestone, softer	1025–1080
	Limestone, shaly	1080–1085

Calciferous and Potsdam	Sandstone, bluish, at	1095 ft
	Gray sandstone at	1106
	Salt water, weak vein, at........	1125
	Dark sandstone at	1135
	Salt water, stronger vein, at.....	1175
	Gray sandstone at	1295
Red granite, probably struck at		1560
Micaceous band, 16 feet thick, at.................		1582
Red granite..................................		1598

A flow of gas of great energy was found on April 3 at 830 feet. It held up at first in open flow a water column of six inches in the casing. This would indicate a production of about 3,500,000 cubic feet for 24 hours. In three days time, however, the open pressure was so reduced that it held up but one inch of water. Even this figure stands for a million feet a day. After the well was completed and the gas from this and all other horizons was gathered into the three inch tubing, the volume was found to be about 500,000 feet a day.

The discovery of this " blower " naturally aroused great excitement in town. For a few hours there was no stock of the drilling company in the market. Golden visions of a " boom " at hand led every one to revise at least mentally the selling price of his real estate, but as the gas vein exhausted its energy the town dropped back to its ordinary business level.

The real features of the situation soon came to be recognized. A volume of 500,000 feet of gas a day under 100 pounds rock pressure would not make a basis for a manufacturing plant, though even for such purposes the amount of gas is too large to be despised, but when applied to the lighting of a city or to a supply of domestic fuel for residents who would be glad to pay for such a luxury, this volume would make a very respectable figure. At 25 cents a thousand it would yield $125 a day. This view of the case came to be accepted by several of the leading business men of the town and several new wells were forthwith ordered.

The first of them was one drilled by J. S. Hazelton, at his residence on N. Washington st. It was finished in October 1897, at a depth of 890 feet. A fine vein of gas was struck at this depth. The well was tubed with two inch pipe. The rock pressure ran up to 100 pounds in 40 seconds, 200 pounds in 3 minutes,

250 pounds in 5 minutes. The open pressure was not recorded but the initial flow of the well was estimated at 1,000,000 feet a day. The wastage of gas was reduced to a minimum by having everything in readiness when the main vein of gas was reached.

Mr Hazelton designed to apply the gas exclusively for household use, where every foot of it stands for comfort, as well as for money value and the waste of it was recognized exactly like the reckless waste of any other form of wealth. The well supplied his house with fuel and light through the winter. Salt water came in later. The tubing was drawn and the well deepened to about 1000 feet. It shows 40 to 50 pounds pressure at the present time.

The second of these wells was drilled by Dr J. W. Kingsley at his residence on E. Liberty st. It was also about 1000 feet in depth. Its gas supply was small and no satisfactory service has been rendered by it.

A well drilled by C. M. Humphrey in the northern part of the corporation for his greenhouses proved successful, but the amount of gas furnished by it is not equal to the demands of his extensive establishment. Natural gas is an ideal fuel for this line of business and the present supply will answer an admirable purpose for the fall and spring months. Its present pressure is 200 pounds.

A fourth well was drilled near the center by Mr George Oster. Its volume is not large but it suffices for light at least in several buildings and also furnishes fuel for the boiler of a 35 horse power engine.

The fifth of these wells was drilled on the premises of the R. M. Wilson factory. It was finished in February of the present year, 1898, at a depth of 1125 feet. At the time it was brought in it gave the best promise of the entire series, showing a rock pressure of 450 pounds to the square inch. It was applied at once to the boilers of the two 175 horse power engines of the factory and kept them running 10 hours a day for a number of weeks. This service, however, proved too severe for the capacity of the well, and, as the gas was specially valuable in brazing and soldering in the factory it was withdrawn from the boilers altogether. The pressure at the present time is 350 pounds to the inch.

Characteristics of the Rome gas field

The last of the Trenton limestone gas fields of New York as at present developed has now been described. No metes or bounds can at present be assigned to it. A half dozen wells have been completed within an area of not more than one square mile and all have secured more or less gas. Most of the gas was derived from a depth between 800 and 900 feet; or in other words, from 200 to 300 feet below the uppermost beds of the Trenton limestone. By comparison with the preceding records it will be seen that the largest production of all the districts comes from this central portion of the Trenton series.

The highest rock pressure reported thus far is 450 pounds. The largest measured volume is 500,000 feet a day, but the estimates of the "blowers" when struck credit them with at least 1,000,000 feet a day. No advantage has thus far been found in drilling wells more than 1000 feet in depth. As a rule the fresh water can be excluded entirely from the well by a casing of not more than 200 feet. But little salt water has thus far been encountered. Drive pipe to the extent of nearly 150 feet is required in the old valley that passes through the town, but in the immediate neighborhood the Utica shale has surface outcrops and in a good deal of the surrounding territory the deposits of drift are very shallow. By competition the price of drilling wells will doubtless be brought down to 75 cents a foot or even to lower rates. No reason is apparent why the one square mile within which the drilling has been confined holds any more buried fuel than any other square mile of the vicinity. Wells, some of them better and some less productive than those described, can undoubtedly be found throughout the region. Occasional "blowers" and occasional failures will be met.

Section 5

Proper use of natural gas

Natural gas is the best fuel known to man. No advance beyond it is possible, but to secure the best results some scientific knowledge is required in regulating its combustion. Since it is the perfect fuel it admits of application to almost every purpose to which fuel can be turned. The principal exception is in the manufacture of iron from its ores and in other similar metallurgical processes. In the working of iron in rolling mills, forges, and foundries, and in the production of steam for all its multi-

farious applications, in the direct use of heat, in the manufacture of glass and cement, in the burning of pottery, tile, and brick, it is, as before said, the perfect fuel. It effects important economies and greatly improves the quality of production at the same time. But superlatives in describing its advantages and value ought to be reserved for its use as a household fuel. It is here that it does the greatest good to the greatest number. It lightens and simplifies the labors of housekeeping to a surprising extent.

The truth is that natural gas ought to be exclusively confined to domestic use. It is too good for any other line of service, too fine a product for the coarse applications already named. It is a profanation of the good gifts of nature to use gas in burning bricks and tile, in calcining limestone, in generating steam, in the manufacture of glass or cement. There is not enough of it anywhere for manufacturing purposes. The most prolific districts for its supply thus far known in the world, have been two areas, each of which can be described with a radius of 30 or 40 miles; one, around Pittsburg, Pa., as a center, and the other around Fairmont, Ind. Though less than 20 years have passed since the first field was opened, and less than 10 years since the second entered on its course, we are already obliged to use the past tense in giving the history of both fields. Gas was applied in Pittsburg to manufacturing uses in every way that ingenuity could devise, but the life of the field could not be maintained under the draft imposed for more than a single decade. In other great gas fields like Findlay, O., the application to manufactures has run even a shorter race.

The amount of gas required in manufacturing necessitates the speedy decline and failure of every gas field, even the greatest. There is not a process to which it is turned, unless it be steam production, in which hundreds of thousands of feet, if not millions, are demanded every day. For steam production, 50 feet an hour for each horse power is probably enough, under careful and skilful use of the gas. This would make the consumption of a 50 horse power engine working 10 hours a day, 25,000 feet.

For glass manufacture, a 10 pot window glass factory would be found to require about 600,000 cubic feet a day. A 10 pot flint glass factory will use about 400,000 cubic feet a day.

Iron working demands by far the most lavish and unwarrantable use of gas of all manufacturing industries. A rolling mill will range from 1,000,000 to 5,000,000 feet a day. How far will a million feet go in the support of household use? A house of 12 rooms, using gas in cooking range, laundry, furnace, and in six grates, uses on an average for the year, about 40,000 cubic feet a month, or 1333 feet a day. 1,000,000 feet would supply 750 such establishments, or what the smallest rolling mill would use in a day would serve such a home for more than two years. But, instead of using 1333 feet a day, the average residence will find all its necessities met by less than one half the amount named. 500 feet will make an ample daily supply for the majority of city or village homes. For such use the amount consumed in the smallest rolling mill in a day will serve 2000 ordinary residences for the same length of time, or would serve one such dwelling for 2000 days. A 10 pot window glass factory uses what would supply 1200 dwellings for an equal length of time.

The sacrifice of human comfort and well being to business greed finds a striking illustration here and can not be too emphatically condemned. The application of natural gas to manufacturing uses necessarily involves such a sacrifice.

The country as distinguished from the village or the city ought not to consider itself excluded from the benefits of natural gas. It seems altogether feasible for well-to-do farmers in districts where gas is easily reached to drill wells for home supply. A well not exceeding 1000 feet in depth can be drilled and equipped for $1000 or less. If it can furnish light and heat for the home for 10 or 12 years the investment will be a safe one even from a business point of view, to say nothing of the incidental advantages that gaseous fuel brings. So also several farmers whose lands are contiguous could unite in drilling a single well and share its production in common. Such a venture might be distinctly advantageous to each, from the point of view already named, viz, dollars and cents. Whoever has occupied for a year a dwelling adequately supplied with natural gas, will recognize so many and so great additions that it makes to the comfort of life that he will not insist on a very close balance of expenditures and credits in dealing with this subject.

When applied to manufactures it is doubtful whether natural gas works in the interests of the general good. It is true that the cost of manufacture is cheapened and the quality of the production is likely to be improved by its introduction. But the fortunate manufacturer who can avail himself of it at once begins to undersell his competitors who are working under the old conditions, because his fuel, which is often the most costly element in his business, costs him nothing. In this way the most prudent manufacturer carrying on his business in the old way may find himself forced to the wall. Competition for him is simply impossible till the storm is past. Meanwhile the manufacturer who uses natural gas finds his business greatly improved in volume for the time being, because of the discouragement and failure of his natural competitors.

Such a state of things is not good for any community. It is much worse when the towns that find gas within their reach invite in manufacturers by municipal grants and the like. Factories come to be established, far from all supplies of essential materials with the one exception of fuel. As soon as fuel fails, the factory is bound to disappear. In many such cases, the last state of the town is worse than the first.

One of the evil results of the use of natural gas in manufactures is the development of the speculative fever called a "boom" in the towns that find gas at hand. Real estate feels the effect soonest. Inflated values derange legitimate prices, and the reactions that are inevitable are always hurtful.

From the temptation to the shameful abuse of applying natural gas to manufacturing purposes the newly developed gas fields of central New York are delivered. In but one of these, i. e. the Baldwinsville field, is the amount of gas large enough to make any figure in such an application and a brief experience in attempting to supply 1,000,000 or more feet a day to individual consumers will satisfy the owners of the Baldwinsville wells that this policy must be short lived and ruinous.

The proper use of natural gas, i. e. household use, is the only one that can bring adequate return to the company undertaking to supply it. It is a source of satisfaction to find that the true use pays best.

The price of gas ought to be increased in every community that is now using it. There is no good reason why it should be sold at any less price than the fuel which it displaces, or, in other words, why the better article should be sold for less than the inferior; in computing the cost of the displaced fuel, account should always be taken of the various items involved, such as its storage and preparation, the cost of lighting fires and the expenses of removing ashes and cinders, none of which enter into the use of gaseous fuel. It may be urged that an increased price for gas would result in extravagant profit for the gas companies. It can not be denied that there is a possibility of such a result, but as a matter of fact there are very few cases in the country in which companies have got back their original investment or see any good chance of getting it back. They are generally obliged to content themselves with generous dividends while the gas is in full flow.

The question of the municipal ownership of natural gas plants has not as yet come up in New York. Theoretically there is almost everything to be said for such a scheme, but practically it is hedged around with great difficulties, most of which can be referred to the unworthy views that prevail in all our communities in regard to the public service. No examples can be brought from the many trials of the system in Ohio and Indiana within the last few years to encourage its introduction into other territory.

Section 6

Summary

The natural gas fields of central New York have now been passed in brief review. A summary of the facts will be here presented.

1 Supplies of gas are found to be derived from several geologic formations, as the Medina sandstone, the Oswego sandstone, the Utica shale, the Potsdam sandstone, but the main dependence is on the Trenton limestone. It is this formation which gives character and value to all the rest. The others would have no considerable significance without it.

2 The gas of the Trenton limestone has the characteristics of shale gas. The several fields now developed do not seem to be connected by structural lines or to be arranged in belts, after

the fashion of the great fields of Pennsylvania and Ohio. The gas apparently occurs throughout the entire formation, except where the physical condition of the limestone is such that storage is wanting. While there can not be said to be any definite horizons of the gas, there are two divisions of the Trenton formation that furnish the main supply. The first is found 50 to 100 feet below the surface of the limestone; the second 50 to 100 feet above its base. There is no dolomite in either of the horizons, but the drillings show the presence in abundance of characteristic Ordovician fossils. The limestone holds comparatively little water and what water is found is generally saline, but not sulfurous.

3 The rock pressure of the gas ranges from a score or two of pounds to 1540 pounds to the square inch. The last named figure is the highest gas pressure known to be reported from any field in the world. From some unexplained cause, the depth at which the gas is struck has a general relation to the rock pressure, but adjacent wells differ widely in the figures reached. The rule seems to be, the deeper the gas vein, the greater the pressure.

4 As to the volume of the gas wells, a large range is also found. The largest volume reported thus far is 3,000,000 feet a day, but the ordinary wells show only thousands or tens of thousands of cubic feet, or, in rare instances, hundreds of thousands. The Trenton limestone is not thus far a source of large wells nor has it proved itself a large producer of gas to the acre or square mile.

5 When wells are wisely used they show a good degree of vitality. This is also characteristic of shale gas.

6 An *exact* determination of the dip of the strata is not possible from the data available. In fixing the different horizons of the rocks we are obliged to depend largely on the discriminations of the well drillers, and there is no certainty that they will agree as to the boundaries of the several formations that they undertake to identify. Neither are their records of the same well in all cases entirely harmonious. There is special liability to confusion in the case of the Trenton limestone. The lowermost beds of the Utica shale are generally highly calcareous, and the highest beds of the Trenton limestone are sometimes

shaly, so that the dividing line between the two formations is in many cases an arbitrary one. A swing of several scores of feet is possible in the fixing of these horizons as they are recognized by different drillers.

The best element in the series, that as to the position of which there should be the least ambiguity, is the upper surface of the Archaean granite. By its hardness it is so sharply contrasted with all other formations that the driller always knows when he has reached it, but there is a chance for discordant measurements, and, as a matter of fact, many of the records are confused and uncertain as to the depth at which the granite lies. Selecting a few records that are at least as good as the rest, we obtain data which can be used in determining the problem of the dip.

In central Jefferson county there is no doubt that the granite lies about 900 feet below the surface.

At Adams, it is given as		915 ft	
At Pulaski,	Oswego county	1425	
At Parish	" "	2445	(?)
At Central Square	" "	2415	
At Stillwater, Orwell township		1697	

Several of these points are on an approximately north and south line and the facts of the dip presented by them are shown in the following tables. Distances are taken from maps and from railroad measurements.

The elevation of the surface necessarily comes into account. The altitude of the points named below are herewith given. The calculations were made on the true elevations, the differences of surface altitudes having been first eliminated.

Adams, r. r. station		599 ft	above tide
Pulaski,	"	377	"
Parish, well head		474	"
Central Square, well head (399.9)		400	"
Mexico, r. r. station		375	"
Baldwinsville,	"	390	"
Warner, r. r. station		427	"
Stillwater,	"	900	"

	DISTANCE	DESCENT	RATE
Adams to Pulaski	22 miles	288 ft	13 ft to mile
Adams to Central Square..	41.4 "	1699	41 "
Pulaski to Central Square..	20.1 "	967	47 "

Taking the Trenton limestone as a base, we find it reported as follows:

Pulaski	550 ft	below the surface
Mexico	1027	"
Central Square	1609	"
Baldwinsville.	2250	"
Warner	2600	"

Calculating on the basis of the facts above given, we obtain results consonant in a general way with those previously reported. They are shown in the accompanying table.

	DIRECTION	DISTANCE	DESCENT	RATE
Pulaski to Mexico..	Southwest	$8\frac{1}{2}$ miles	479 ft	41 ft to mile
Pulaski to Central Square	South	22 "	1036 "	47 "
Pulaski to Baldwinsville	Southwest	30 "	1687 "	56 "
Baldwinsville to Warner	South	$5\frac{1}{2}$ "	313 "	57 "

The figures of the tables above given will allow still other calculations than those that have been made. The calculations establish the fact that the strongest descent is in a southwesterly direction and that the dip increases slowly to the southward.

It has been a genuine surprise to find at this late day any part of central New York in possession of a considerable stock of stored power. The form in which this stored power is found is the most uncertain and in some ways the hardest to control of all its forms. But it is after all delightfully adapted to the service of man and can not fail to be appreciated and valued when its true character comes to be understood.

For the first century of its occupation in a large way the state depended for fuel on the noble growth of forests with which its surface was originally covered. 50 years ago, its forests being no longer able to meet the ever-increasing demand, specially for power to use in locomotion and manufactures, it began to draw

on the coal fields nearest to its limits. The coal field that it found most accessible was beyond question the noblest body of fuel known in the crust of the earth, viz, the anthracite field of northeastern Pennsylvania. By the middle of the 20th century, that is, in 50 years from now, if the present rate of consumption and the present rate of increase of consumption are maintained, this great treasure house of stored power will have been practically exhausted. Whenever this consummation is recognized as imminent, a new appreciation of all the forms of stored power, as winds, rivers, and soils, will be sure to be developed, and then the knowledge that a tract of land contains within its boundaries all the fuel and artificial light that its owners will require for decades, generations or centuries, will certainly become a factor in the value of such property.

Chapter 4

Lake shore natural gas belt of Chautauqua county

The belt of country bordering Lake Erie in Chautauqua county is a beautiful and favored tract. Its southern boundary is the continuous escarpment that faces the lake, five to seven miles back from its shore and which rises to 800 feet above its level, within the distance named.

The surface of the belt is occupied with two lines of transported material, viz, 1) the glacial drift, with its usual variety of composition; and, 2) deposits from the lake when it held a considerably higher level than at present. Under the first division we find wide stretches of boulder clay, giving rise to strong but heavy soils; the latter are often blackened by organic matter due to the swampy conditions of an earlier state. Under the second we note specially the extensive beds of sand, gravel and loam which mark the beaches or lake ridges that were thrown down in the higher stages of the water. These last accumulations give rise to warm and mellow soils which are also generous and productive.

To the advantage of the soil must be added that of climate. The immediate neighborhood of Lake Erie insures late springs, thus averting to a considerable extent the danger from spring frosts; while the presence of the same body of water, warmed by the heat of summer, holds off autumn frosts, thus allowing time enough for the ripening of grapes.

These two elements, soil and climate, have led to the recent transformation of a considerable portion of this belt into vineyards, orchards and gardens of small fruits. Probably this fruit culture is more indebted to climate than to soil, for we find vineyards as successfully established on the heavy clay lands as on the gravelly loam. On the clay lands their fruit requires a somewhat longer time for ripening, but is counted of finer quality.

At best the surface deposits of this lake shore belt are thin. It is rare to go down more than 20 to 30 feet without reaching bedded rock. The largest streams of the district all occupy new valleys, as is attested by the narrow rock-walled and rock-bottomed gorges in which they flow. The altitude of the most characteristic portion of the belt is 650 to 750 feet above tide. The differ-

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Fig. 1-5 AMANITA CALYPTRATA ALBESCENS Pk.
CALYPTRATE AMANITA

Fig. 6-10 AMANITOPSIS VOLVATA ELONGATA Pk.
TALL AMANITOPSIS

ence between the southern upland and the lake shore belt in both soils and climate is very marked, depending both on elevation and the presence or absence of the moderating influence of the lake.

The belt under consideration is wholly occupied by the shales of the Portage and Chemung groups of which countless outcrops appear in the valleys and gorges of the region.

The Portage beds occupy the immediate shore of the lake from Cattaraugus creek, which is the eastern boundary of the county, to the northeastern corner of Ripley township, where they descend to the level of the lake and are succeeded to the westward by the lighter colored but scarcely distinguishable shales of the Chemung group. Dark bands are frequent in the Chemung series also, but they are not as black as those found in the Portage. The most persistent element, according to Dr J. M. Clarke of the New York survey, is a sandstone bed, the place of which is near the top of the Portage. This bed is well shown in the quarries of Canadaway creek at Laona, three miles above Fredonia, and in the bed and banks of Chautauqua creek near Westfield and in many adjacent ravines. It can be distinctly traced for many miles as it affords the only building stone found in that part of the county and is accordingly opened, at least in a rough way, for neighborhood use, wherever its outcrops occur. The stone is, however, very hard, and has a great number of what the quarrymen call "dry seams," which give rise to frequent and irregular fractures.

The principal roadways through this belt follow in the main the old lake-ridges or beaches already referred to. The materials of these ridges are almost ideal materials for road making, and the roads of the region consequently have a high degree of excellence. There are few finer natural roads in the country than the main road from Buffalo to Cleveland and the Chautauqua section of it shows it to the best advantage.

The views across the fruitful plain here described from the summits of the uplands which constitute its southern boundary, 800 feet above the lake, are of unsurpassed loveliness. They are worth going many miles to see. The one to be obtained from the summit back of Westfield, to the west of Chautauqua creek, may be instanced as among the best.

To its fine and varied soils, with all that these imply, and its admirable and well tempered climate, the lake shore belt adds another advantage that has not yet come to due recognition. It holds in the uppermost 500 to 800 feet of shales that begin its geologic section, a stock of natural gas, not large in amount and low in pressure, but easily obtained, easily controlled and fairly persistent, from which the artificial light and heat of the region are already furnished to a small extent, and the supply of which can be increased and multiplied almost indefinitely. It is this last named element that is to be discussed in the present chapter.

Special interest attaches to the natural gas of the county because of the fact that utilization of it was begun here at an early date. The experience of Fredonia takes the foremost place in this connection. In fact, this little village, with its insignificant supply of natural gas, leads the way in the history of gas utilization in this country and is also widely known in the old world as well. This history will occupy the opening section of the present chapter.

a *Fredonia (Pomfret township)*. Fredonia is a beautiful village situated immediately below the main beach or ridge which runs parallel to the present shore, separated from it by an interval of two to three miles and higher by about 200 feet. The size of this ancient beach and the amount of material composing it show that the lake stood for a long period, as time is counted in human history, at this level. Centuries at least would be required to account for its work. The present outlet by Niagara river had not yet been opened. Canadaway creek flows through the village. It is a considerable stream for Chautauqua county; in fact, one of the three largest of its list. It has a drainage basin of about 50 square miles, gathering its water in Arkwright and Pomfret townships from an altitude 600 to 900 feet above the lake. This gives a rapid descent to the stream. It occupies a new valley which it has worked out of the bedded rocks already named. From Laona northward, the valley is cut entirely in the Portage shales. The valley does not follow the joint lines of the formation but cuts across them at various angles.

The direction of the joint lines of the shales was measured for the survey by Ezra S. Ely, a civil engineer of Fredonia. There

are two sets of the joints, one being called north and south and the other east and west. The first set, instead of running in a due north and south direction, follows nearly a northwest course. (North 47° 45′, west, magnetic; true course, north, 52° west) The joint lines vary among themselves as much as three degrees. The cross joints are more frequent than the first set and cut the latter at an angle of 48° 30′, varying to 51° 15′ by needle. This brings their direction very nearly east and west. The north and south joints are not vertical but incline to the east, the extreme deflection measuring $2\frac{1}{2}$ in $10\frac{1}{2}$ inches. The cross joints incline to the southward. The intersection of these two systems result in the formation of oblong blocks, approaching regularity, which appear abundantly in the waste of the stream.

From some of these joints, gas constantly escapes. The currents are much weaker, however, at the present time, than they were in earlier days. When water occupies the openings formed by the joints, the gas appears in bubbles, forcing its way through the water. Such springs were known by the early French explorers of the country as *fontaines qui bouillent*.

Several of the most notable of these gas jets were situated in the bed of the creek within the limits of the village of Fredonia. The past tense is used in describing them for the reason that the escapes are too feeble to attract notice now, or have died out altogether.

These gas springs or jets could hardly escape the attention of the earliest human occupants of the region, white or red. Tradition says that the particular gas spring that gave such celebrity to the village in this connection was discovered by a traveler who went down into the creek bed for water and shade as he ate his midday lunch. This spring was located by the side of the Buffalo and Cleveland road, the oldest and by all odds the most important of the lake shore highways, where it crosses Canadaway creek. After the traveler had finished his meal and was striking a light for his pipe, he ignited the escaping gas. Whether the discovery was made in this way can never be determined; but there is an air of verisimilitude about the story that commends it to us. Certainly the discovery could well have been

made in some such way. Gas has no doubt been discovered scores or hundreds of times in this formation in similar ways.

At any rate, it became known in the early years of the century, when the permanent occupation of the lake shore belt was taking place, that inflammable gas was found in the bed of Canadaway creek, and indeed in many similar situations in this region. The surveyors of the Holland land co. were among these early discoverers. Moses D. Tennant, of Westfield, found in one of their old field books mention of a spring which emitted an "odorous air." The surveyors had traced it by the odor and had also found that this "odorous air" could be ignited. A score of years passed after this discovery before any new steps were taken in regard to it.

It was probably in 1821 when drilling was begun in Fredonia in the smallest experimental way for natural gas. Though the exact date is uncertain, the order of events is still held distinctly in the memory of some of the oldest residents of the village, who knew the persons concerned in the development and repeatedly heard the account of the several steps from their lips.

Two grist mills (flouring mills) had at the date named been established in Fredonia, one, north of the "Buffalo road" in the valley of the Canadaway and in almost immediate contact with the best known gas spring of this region; the other 15 to 20 rods south of the road above named and in the same valley. A woolen mill, in which home-made woolen cloth was manufactured was afterward built, immediately north of the second grist mill, by a man named Edward Howard. Mr Howard occupied for his residence a house directly across the road from the mill. The water well on his premises was unsatisfactory, being shallow in depth and its supply failing in dry seasons. The tail race of the grist mill passed directly under Howard's woolen mill, leaving the shale floor uncovered and plainly in sight below the mill floor. It occurred to Mr Howard to test the shale with reference to a better water supply for his dwelling, and he accordingly began work with an iron bar a few feet long, that was kept about the mill. After drilling into the shale beds a few feet, he observed bubbles of gas escaping through the water. He farther found that the gas was inflammable. Howard had a friend and companion in the person of William Aaron Hart, a gunsmith of

the village. Hart visited the mill from time to time and became interested in his neighbor's experiment and its outcome and determined to follow up farther the gas vein that had thus been disclosed. He continued working in the hole that Howard had begun under the mill till the extemporized drill gave way. In short, the drill broke, and the bottom of it was left fast in the shale bed, thus shutting off the principal flow of the gas already noticed. Not satisfied with this attempt, Mr Hart forthwith set about drilling for gas in the valley near by. The location was between the grist mill and the woolen mill. He went down 40 feet at this point, but found no considerable volume of gas. Still undiscouraged, he made one more effort to locate in the shale some one of the gas veins which had been escaping in the small way for centuries. He began this third trial in the valley north of the main road, and in fact just where the best-known natural flow of gas of the neighborhood had been observed.

How deep he sank the drill here can not now be ascertained. Some think that he went down 70 feet into the shale. At any rate, his search was successful. He found what was counted a good vein of gas and entered at once on its utilization. He constructed a rude gasometer in which to accumulate the gas and placed it under a still ruder shelter of undressed boards. He purchased light lead pipe, three quarters of an inch in diameter, and connected the gas with the old hotel (the Abell house) located where the Columbia hotel now stands. He also laid pipe to several of the stores on the opposite side of the street from the hotel. The natural gas supply of Fredonia was thus begun. The entire credit of its discovery and utilization belong to one man, William A. Hart. In his labors he showed both persistence and practical sagacity. We can well afford to honor his name.

This brief history made a profound impression on the country, specially when the condition of the times was taken into account. Fredonia was on the most common line of travel for this part of the country in that day, viz, the stage line between Buffalo and all the west which was then occupied. Travelers passing through Fredonia would be sure to have their attention called to the fact that here was a town lighted with natural gas; the first, certainly, in this part of the world. The phenomenon also attracted the attention of scientific men. The elder Silliman,

the distinguished professor of Yale college, published in 1831 an account of this experience in the scientific journal which originally bore his name and which afterward became the *American journal of science and art.* Fredonia became known even in foreign lands, on this same account. Sir David Brewster, the eminent scientist of Scotland, republished this same account in the scientific journal which he edited. As to the author of the account it is to be regretted that we have no knowledge. It was evidently furnished by some eye-witness of the phenomena. There are some inaccuracies in it, geologic and otherwise, but it clearly shows the interest excited by the facts. The article was copied, during the years to come, in many of the newspapers of the country. The account is as follows:

A village lighted by natural gas

The village of Fredonia, in the western part of the state of New York presented this singular phenomenon. The village is 40 miles from Buffalo and about two miles from Lake Erie. A small but rapid stream called the Canadaway, passes through, and after turning several mills discharges itself into the lake below. Near the mouth is a small harbor and lighthouse. When removing an old mill which stood partly over this stream in Fredonia three years ago, some bubbles were observed to break frequently from the water, and on trial were found to be inflammable. A company was formed and a hole, an inch and a half in diameter being bored through the rock, a soft fetid limestone, the gas left its natural channel and ascended through this. A gasometer was constructed and a small house for its protection and pipes being laid, the gas was conveyed through the whole village. 100 lights are fed from it, more or less, at an expense of $1.50 each. The streets and public places are lighted with it. The flame is large but not so strong and brilliant as that from gas in our cities; it is, however, in high favor with the inhabitants. The gasometer, I found on measurement, collected 88 cubic feet in 12 hours during the day. But the man who has charge of it told me that more might be secured with a larger apparatus. About a mile from the village and in the same stream it comes up in quantities four or five times as great. The contractor for the lighthouse purchased the right to it and laid pipes to the lake, but found it impossible to make it descend, the difference in elevation being very great. It preferred its own channel and bubbled up beyond the reach of the gasometer. The gas is carburetted hydrogen and is supposed to come from beds of bituminous coal. The only rock visible here, however,

and to a great extent along the shore of the lake is fetid limestone.—*Silliman's journal*, 17:398

Gen. LaFayette on his second and final visit to the United States in 1824–25, witnessed the unique spectacle of a village thus illuminated, and though not of a scientific turn, he could not fail to note the great interest of the facts. One of the oldest residents of Fredonia, Mr D. A. White, has given a circumstantial account of his visit, which was perhaps the most conspicuous event in the early history of the village and of which, as a lad, he was an eye-witness.

The general had wintered in the southern states and coming up the Mississippi and Ohio valleys had reached the boundary between New York and Pennsylvania near Jamestown, early in June 1825. He was brought from Mayville to Fredonia by Judge William Peacock, the first agent of the Holland land co. on June 3. Delays occurred in the journey and he did not reach Fredonia till two o'clock Saturday morning, June 4. He was en route for Dunkirk, where a United States sloop of war awaited him to convey him to Buffalo. A great throng had gathered to greet his arrival at Fredonia, including the military company of the village, which was to march as a guard of honor to Dunkirk. Refreshments were served, even at this untimely hour, by the light of natural gas, and Gen. LaFayette must be credited with this early experience in the use of a substance which we commonly think of as a discovery of our own times.

The well and its equipment changed hands after a little, passing into the possession of Jesse H. Starr, who followed the line of policy already established in the utilization of the gas. He seems, however, to have raised the price a light to a figure more nearly commensurate with its real value. The charge became $1.25 a quarter, or $4 a year, but the number of lights was insignificant. Some authorities say that 30 lights were supplied by the well, but others declare that the number did not exceed 12, at most. From the account in *Silliman's journal*, already quoted, it seems that the original price a light was $1.50 a year.

Jesse H. Starr died in the course of a few years, and his property, including the little gas plant, passed into the hands of his legal heirs. It became the duty of a brother, Joseph Starr, to

manage the gas plant for the benefit of the heirs and he continued the supply till about 1858, when a new stage in the history was opened. Before entering on this second stage, several facts of interest in the same general connection will be put on record.

The pride that Fredonia took in its unique source of artificial illumination is expressed in the village seal that was adopted in 1829. A photographic reproduction of an impression of the seal is herewith presented.

For the copy the survey is indebted to Mr D. A. White, whose kindly interest and service have been already noted. The size of the seal is reproduced in the engraving. It represents a gas pipe with five burning jets attached.

In 1829, or thereabouts, an attempt was made by Walter Smith, to furnish gas for the government lighthouse at Dunkirk. It is mentioned in the account in *Silliman's journal* previously quoted. In this attempt, Mr Smith was following an example already set in the lighthouse at Barcelona, 20 miles west, which will be described on a subsequent page. Mr Smith got possession of another gas spring in the creek bed, a mile nearer the lake than those already described. So sure of his ground was he, that he proceeded to lay a pipe line from the spring to the lighthouse. The pipe line consisted of pump logs properly joined together and two miles of such material laid in

the ground meant a not insignificant expenditure for the time at which it was made. The projector of the gas line had, however, overlooked two important points, viz, the difference in elevation between the spring and the lighthouse and the specific gravity of the gas. The latter is only about half the gravity of air. The spring is about 150 feet higher than the lake, and when the gas was turned into the line it had force enough to send it only half the distance required. Because of these facts the plan fell through.

The second stage of the history has already been referred to as beginning in 1858. Preston Barmore is the most conspicuous figure in the opening of the new chapter. In the year named, he began the development of a new and independent gas supply, one mile farther down the stream than the Main st. well. A notable escape of gas had been observed here from the earliest times. The boys of the village were familiar with it and had long carried on various qualitative and quantitative experiments of their own about it. The location was on the famous Risley farm where so many of the garden seeds of the early time were raised.

Mr Barmore secured a quarter acre of this tract in a strip a rod or two wide, adjoining the creek, and proceeded to dig a well near the gas spring. He had evidently studied the production begun by Hart 30 years before and had drawn from this two important inferences, viz, 1) that natural gas is to be found in the strata underlying the village, and 2) that the people were glad to pay for it, wherever and in whatever quantities it could be supplied, and he saw room here for a profitable investment of energy and capital.

The handling of the gas had heretofore been conducted in the village with the insignificant expenditures already reported. The original well had been drilled on the lands of the McPherson mill and the royalty on the gas was all embraced in the furnishing of two lights to the mill, the cash value of which, according to the original schedule of prices, was $3 a year. The drilling of the well had been accomplished in the same inexpensive way, the gunsmith, Hart, probably sharpening his own tools, and very likely doing the drilling himself at such times as he could obtain from his other engagements. Probably the only considerable

expenditure was that of purchasing the few hundred feet of lead pipe, three quarters of an inch or one inch in diameter, to convey the gas to the hotel and stores where it was burned. The gasometer is said to have had a capacity of 800 cubic feet, while the little shed that covered it was of rough lumber and its construction of the cheapest possible description.

In the autumn of 1858, Elias Forbes bought a half interest in the Barmore enterprise and a company was formed under the name of the Fredonia gas light co. This company is still in existence. The well on which the new business was to be established is said in one account to have been 30 feet in depth, with a diameter of six feet at the surface, increasing, cistern-like, to 20 feet at the bottom, where two vertical holes were drilled in the shale, one to a depth of 100 and the other to a depth of 150 feet.—Hamilton Child, *Chautauqua county directory*, 1874-75.

For the remainder of the year 1858 and for the next year about 2000 feet of gas were supplied to the village line every day. A gasometer of 12,000 cubic feet capacity was constructed and the introduction of gas into private residences for illumination was begun. In the course of a few years from that time, three miles of mains had been laid within the corporation limits, and for the first time the early designation of "a village lighted by natural gas" could be truly made as to Fredonia.

The company was soon obliged, however, to introduce manufactured coal gas into its pipes to maintain an adequate supply. They built retorts for themselves and found that by the introduction of a quantity of natural gas, the service of the coal gas was greatly improved.

A third stage in the history may be said to begin in 1871, when Mr Alvah Colburn drilled a deep well at his mill (the old Norton and Lester site, south of the Main st. bridge) for the purpose of obtaining fuel for the boiler of his mill. The Colburn well was drilled 1250 feet deep. A considerable supply of gas was obtained between 130 and 300 feet below the surface, but not enough for the boiler. Mr Colburn accordingly offered the gas to the company that supplied the village, and its service was greatly improved by the addition. This well is said to have produced about 4800 feet a day for a number of years and its rock pressure, the maximum of which it required 10 hours to accumu-

late, was 97 pounds. Mr Colburn sold the gas for $1 a thousand. This arrangement was continued for several years, till in 1875 he bought an interest in the company and finally bought out the entire plant. To keep up the gas supply he continued to drill new wells till he had put down 12 in all. These wells were 300 to 800 feet in depth. Six of them proved to be dry, but four of the original number are still producing gas. For 10 years he maintained the supply in this way, but with increasing difficulty. He then entered into a contract with the Gas co. of Dunkirk to undertake the supply.

The Dunkirk gas co. laid a four inch line to Fredonia, which is still in use, though no longer fully adequate to the demand. In order to close out its dealings with the Colburn estate, the Dunkirk company has recently sold the plant to Dr M. M. Fenner of Fredonia, president of the street railroad co.

In the Colburn deep well no. 1, the Corniferous limestone was reached at 1079 feet below the surface. Drilling was continued in the limestone 177 feet, thus making the total depth of the well 1256 feet.

Gas wells do not as a rule last more than four or five years at present, while formerly they retained vitality for at least twice that length of time. There are so many ways for water to find access now, that the wells are almost certain to be overrun within the limit named.

Leaving out of present account the various attempts to obtain gas from shallow wells for domestic supplies, which have been made within the last 15 years, it is necessary to put on record the resolute effort to find some large supply of gas that could be turned to account for manufacturing purposes.

This movement was no doubt inspired by the developments in Findlay and Lima, O., which began in 1884, and were under full swing in the course of the next year or two.

The reasoning in regard to the probable presence of high pressure gas at Fredonia was very convincing to those that had not studied the subject. It ran on this wise: "Gas has been seen to be escaping from the shales that underlie this region ever since it was first occupied. It was so at Findlay, O., but by boring a well there 1000 feet deep, an enormous volume of gas was brought to light, having a rock pressure of 400 pounds to the inch; why

should it not be so here?" By the autumn of 1886, this line of argument had served to convince a great many of the good people of Fredonia. It was reinforced by the appeals of a practical well driller, Mr J. W. Moore, of Warren, Pa. A public meeting was held in this interest in the latter part of August. Mr Moore offered to sink a well 2000 feet for $2000, and was willing to take $500 stock in the enterprise.

Most prominent among the friends of the project in Fredonia was Mr C. C. Camp. A company called the Fredonia gas and fuel co. was forthwith organized. $2000 was raised, and by September 1, the drilling contract was let. The officers of the company were C. C. Camp, president; O. D. Baldwin, secretary; F. R. Green, treasurer. A lot of one half acre in extent was bought of the Canning co., a half mile to the southeast of the village. By the last of October the tools were at work. By the middle of November the well was 1000 feet deep. At 1125 feet, the Corniferous limestone was reached, 46 feet lower, apparently, than in the Colburn well, but the difference of elevation in the well heads would cover much of the difference found.

At 1400 feet the tools were lost for a time. In December, the 2000 feet limit of the contract was approached, and at 1904 feet a strong vein of salt water was reached. The well had been drilled wet thus far. The first effort to exclude the water was by introducing 1700 feet of casing, which was presently found ineffectual. A few weeks later the casing was withdrawn and reset at something over 1900 feet.

The depth of 2000 feet was reached on Mar. 16, 1887. About this date the contractor visited the new fields of Ohio and reported great encouragement in regard to the Fredonia well from the facts that he found in the Findlay field. He urged that the well should be drilled 500 feet deeper. At 2100 feet, in the Medina sandstone a small gas vein was struck, but the drill soon passed into the red mud of the same formation. The contractor was reported as counting the situation favorable "for a strike in the next stratum below." When 2500 feet were reached, as nothing of value had been discovered reasons were found for drilling still deeper and still farther subscriptions were raised. The summer of 1887 witnessed but little progress in the work. Soon after starting on the last 500 feet stretch, the tools became fast

and were never got loose again. Nothing came from the expenditure of the $5000 raised among the people, except the insignificant volume of Medina gas above referred to and the valuable experience accumulated in the progress of the work. This experience served to uproot the delusion that because the slates of the surface everywhere carry low pressure natural gas, the deeper rocks must be charged with great volumes of high pressure gas.

The Medina gas vein, to which reference has been made, had a rock pressure of 150 to 160 pounds. Its daily production was about 7000 cubic feet. The vein has thus far proved persistent. The gas has but little illuminating quality. It was turned at first into the city gas mains, but its introduction brought instant protest from consumers. It has, however, excellent heating power. For the last five years it has been owned and controlled by Mr G. S. Phillips, who supplies his own residence and the houses of several of his neighbors with fuel. The well provides for four winter fires and for eight fires in summer. The property of the original company, including lands, well and fixtures has changed hands several times. In one instance it was sold for one tenth of the money originally invested. Even the small income resulting from the use described in the last paragraph will pay interest on the price thus reduced.

This prolonged experience of more than half a century had made it plain that the shales underlying Fredonia were everywhere charged with small quantities of low pressure gas. Gas escapes occur in the beds of all the streams, the only portions of the surface where the shales are entirely uncovered. In digging wells, also, inflammable gas is frequently found when the shale beds are approached.

This fact has naturally led to the drilling of numerous wells in and around the village, the sole object of which has been to obtain gas for artificial light and heat.

The most important cluster of these wells at the present time is on Central avenue about half way between Fredonia and Dunkirk. They are well represented by the three wells drilled by Festus Day, on his premises, for the supply of his own residence. Two of the wells were drilled 15 years ago, and have furnished

a full supply of light and heat for his own use ever since. The third well made no noticeable addition to the supply.

These wells are about 100 feet apart and 300 feet deep. They do not appear to affect one another in production. The gas is found at slightly different depths in each. The chief horizons where gas is expected are from 80 to 90 feet, 100 feet, 125 feet, and 165 feet. At 60 feet a small vein of strong saline and bitter water is found. All the water found in the shales is saline, but it can generally be exhausted by persistent baling when the vein is struck and when once reduced it makes but little farther trouble. When allowed to lie on the gas veins, however, it soon weakens or destroys them.

Mr Day is a practical oil producer and has thus recognized from the first the necessity of constant care of his wells. He never allows water to accumulate in them, but pumps them at least four times a year. To this care he attributes their continued vitality. The regulator is set at four pounds. He never shuts in a well completely, fearing that under the pressure new channels in the shale would be opened for the gas. In summer he sells the surplus gas. In past years he sold to the Dunkirk gas co. at 25 cents a thousand, but of late years, his neighbors are glad to pay $1 a thousand for all that he can supply. His income from this source sometimes reaches $30 a month. Taking everything into account he has probably received, during the last 15 years, as much money from his wells as he originally invested in them, while obtaining his own light and fuel free of cost. A moderate estimate of the amount saved in the last named items is $100 a year.

The neighbors of Mr Day, influenced by his example, have drilled many wells. Mrs D. L. Barker has one that has furnished the entire supply of light and fuel for her residence for the past 16 years. Dr Rolfe has a fair well, removed but a little distance from Mr Day's wells.

The cost of drilling and equipping a well 300 feet deep will not exceed $175 or $200. If such a well supplies a residence with light and fuel for two or three years, it has paid for itself amply, and if, thereafter, it keeps up the supply for 10 or 12 years, it has proved an excellent investment, better, in fact, than most men know how to make for themselves.

Nearer the village, still other wells have been drilled, but as a rule without equal success. Of the six wells that Dr Fenner has drilled on his home property, only one is reported to be as good as those already enumerated. When these wells fail it is generally through neglect in leaving the salt water on the gas veins.

The possibilities of a gas supply are to be found on many farms of the township, but it costs something to equip a house for the use of this fuel, and there is also an inevitable risk of failure in drilling a well. Considerations founded on such facts have held back farmers, as a rule, from making trial of their home supplies. The gas stock, however, remains safely stored in the rocks and as time goes by all of it will certainly be brought into requisition.

Comparatively little exploration in the way of drilling has been carried on in the townships of Dunkirk, Sherman and Hanover, but there is no reason to doubt that there are probabilities of natural gas supplies in all of them. In the western townships of the lake shore belt, considerable development has already gone forward. Three townships, Portland, Westfield and Ripley, will be taken up in the order named.

b *Portland.* The principal development in this township is on the eastern side and in the neighborhood of the village of Brocton. More than 40 wells have been drilled in the immediate vicinity of this village of which at least four fifths are successful as sources of light and heat. They also show good staying properties, a number of them having maintained their supplies for 10 or 12 years, without apparent reduction. The gas supply in the main is derived from depths in the shales between 25 and 250 feet. In a very few instances gas has been found lower than 250 feet, but no case is recorded in which it has been found 100 feet lower. Several wells have been drilled to 600 and 800 feet but no additions worth noting have been obtained in the lower portion of the sections. The gas is generally reported as derived from the black shale beds. The drillings or cuttings of this shale are reddish brown. This fact has sometimes led to naming the stratum in which the gas is found a "chocolate slate."

Water is always met in the wells. Near the surface of the shales the most reliable accumulations of fresh water for human

use occur. Great account is made of this fact in establishing domestic supplies. Good wells are generally possible at this horizon. As the drill descends into the shale, salt water is invariably struck. The strongest flow is generally met at about 70 feet below the surface. After being baled out at the time of drilling, a little will seep into the well, but less rather than more than one barrel a year.

Mr W. A. Crane, a driller of considerable experience in the oil fields of Pennsylvania, and who has done a large amount of work here for many years, recognizes some low anticlinals in the strata, trending to the southwest or south, but he is not able to detect any influence exerted by them on the gas production.

The rock pressure generally ranges from 60 pounds downward. A pressure of 25 pounds is counted eminently satisfactory throughout the township. Petroleum is sometimes found in small amounts. It occurs in a stray sand that is sometimes found in the shales. The oil is dark and heavy, serving for a natural lubricant when it is produced. The amount is in all cases small. A few barrels will exhaust the largest pocket.

The majority of the wells of the township are naturally in and directly around the village, but successful tests have been made north, east and west of this center. A rough list of wells drilled up to the present is here inserted.

Brocton bank	Haynes
Burton	Kinney
Butler, 3	Martin
Capwell	May, Harvey
Corell	Peck, 2
Crandall	Pettit
Crane	Powell, 2
Devenpeck	Ryckman, 3
Dunham	Smith, Frank
Edmunds, 2	Sullivan
Fay, E. H., 3	Unthank
Fuller, G. W., 2	Wenborne
Harris	Windsor
Hart	Wittmeier

S. B. Unthank found a peculiar condition in his well west of the center of the township. The gas appeared like vapor and

furnished an unusually brilliant light. The volume was also apparently satisfactory. It was estimated that the well would supply 10 or 12 stoves. It was drilled to a depth of 480 feet. For two weeks it rendered the best of service and then suddenly went out, like a light extinguished by a gust of wind. The facts reported make it seem as if one of the little petroleum pools already referred to had been tapped in this instance.

The Wenborne, Devenpeck and Sullivan wells were also failures, and one of the three Butler wells was also unproductive. All the others in the list have yielded more or less gas.

The amount yielded by some is very small, enough for a few lights only, while the daily production of others would show several thousand cubic feet. The C. N. Wittmeier well is probably so far the best well in the township. It is located a mile or so northeast of the railway station. It furnishes the entire fuel for two houses and in winter has kept three stoves in the wine cellar supplied, and has maintained, besides, 40 or 50 lights. All this service it has rendered without the rock pressure being depressed below 25 pounds. It was drilled four years ago and thus far has shown no appreciable shrinkage in quantity.

The next best well is that of Frank Smith, a mile east of the village. It does duty of the same general character as that above reported.

The Haynes well is exceptional in having required the longest string of casing known in the township, namely, 212 feet, salt water having been encountered near that depth. Its rock pressure is also the highest reported, namely, 60 pounds.

The Dunham well has an interesting history. It was drilled for Mr T. S. Moss on his own village lot. While visiting Ripley a few years since he saw a well that was being finished in the shale, the rock pressure of which was 25 pounds. He said to the driller that he would give him $1000 if he would find as good a well for him at his home in Brocton. The driller accepted the offer and put down a well on Mr Moss's village lot 600 feet deep, but the amount of gas seemed small. He shut it in, however, and put on a gage. In the course of two or three days the gage showed a pressure of 28 pounds. The driller accordingly demanded his money, but Mr Moss demurred. He feared that the gage had been tampered with. A second gage was borrowed

from the mill near by, but that showed the same pressure. Still hesitating to accept the testimony of the gages, Mr Moss obtained an instrument from the great locomotive works in Dunkirk, the reliability of which was guaranteed. When this confirmed the reading of the two already put on the well he saw that the driller had fulfilled his contract and made payment. This was 12 or more years ago. The well has been running ever since and without appreciable reduction in volume or pressure. It has kept the house constantly supplied with fuel and light and has never been uncapped. Though the driller received two prices for his work, the owner never made a more profitable investment.

G. E. Ryckman has drilled three wells on his premises. The first was carried to a depth of 400 feet, but there were no additions of gas below 200 feet. This well has kept the kitchen stove supplied with fuel for 12 years and has also furnished lights for the premises. The second and third wells have made but a small addition to the supply derived from the first.

c *Westfield.* This town has had almost as conspicuous a connection with natural gas as Fredonia. From a spring within its limits gas was conveyed in the early years of the century to the government lighthouse at the harbor on Lake Erie, furnishing in all probability the only light of this sort ever used in the world. Gas has also been developed by many wells in the village and applied to household service. Several deep wells have also been drilled here, but without results, except as they may have made some small contributions to our geologic knowledge. The lighthouse supply will be first described.

The harbor of Westfield was called in the early days, Portland harbor. The name was afterward changed to Barcelona. Chautauqua creek, which flows from the "hight of land," to the southward (the dividing ridge between the waters that flow into the Gulf of Mexico and those that are discharged into the Gulf of St Lawrence) is one of the largest streams of the county. It unwaters Westfield township and Chautauqua township in part, the balance of the drainage of the last named township going by Chautauqua lake to the Ohio river and thus to the Gulf of Mexico.

The descent of the creek from the upland, 1200 to 1400 feet above tide to the level of Lake Erie, 573 feet above tide, is mainly accomplished in three or four miles. The stream has cut its way through the soft Chemung shales, in a deep and picturesque gorge, the nearly vertical walls of which sometimes exceed 200 feet. Many short ridges of shale extend into the valley on either side, generally marking sharp bends in the main stream, but in some cases being referable to the entrance of adjacent tributaries.

The ridges are known as " hog's backs," " camel's backs," " pyramids," etc. In the lowermost two miles of its course the creek reaches the Portage shales and exposes in its bed and banks the upper members of this formation.

This deep channel held an important place in the exploration of the country by the French during the 18th century. Their parties were accustomed to cross from Canada to the Ohio valley and return by this very route. From the mouth of Chautauqua creek, which afforded a safe harbor for the small boats of which they made use, to the beautiful sheet known as Chautauqua lake, a portage not to exceed eight or ten miles was required. From Chautauqua lake the descent to the Ohio river at Fort Duquesne (Pittsburg) was easy, through the channels of the Connewango and Allegheny rivers. The old French road from the mouth of the creek was well known to the early settlers of the county. It was called the old Portage road. It crossed the Buffalo road (the main ridge road) one mile west of the village of Westfield. The point of crossing is now marked by an appropriate stone monument.

For the first half of the century Portland harbor received more or less attention from the general government. From 1820 to 1850 it was a fairly important harbor. Steamboats landed there daily or at least regularly during the summer months, and sailing vessels also found their way in numbers enough to cover all the business offered. But with the building of the Lake shore railroad the importance of Portland harbor ceased. The entrance became obstructed by the formation of sand bars derived from the materials transported by the creek in floods. The docks and piers passed into decay and after a little the harbor was entirely abandoned except by fishing boats.

A lighthouse was built for the government by Hon. T. B. Campbell of Westfield in or about the year 1828. Judge Campbell also owned the gas spring that had been recognized by the surveyors of the Holland land co. in the note already quoted from their field books. This spring, as indicated by the surveyors, was on lot 16, township 4, range 14. Influenced without doubt by the example of Fredonia in its recent utilization of natural gas, it appears that Judge Campbell made an agreement to pipe the gas from his spring into the lighthouse and to supply the lights for the same price that the government would pay for the oil required to maintain them. We learn this from two records in a publication of the general government entitled *Documents relating to lighthouses*, 1789-1871. The first of these records is a report from Lieut. C. T. Platt, dated Geneva, N. Y. Nov. 26, 1837, (page 57). It reads as follows:

Portland lighthouse. Lighted with natural gas, 11 lamps and reflectors. Stationary. Owing to a failure of gas that may be attributed to the extreme drouth, oil is now substituted. It is presumed, however, that the fall rains will replenish the streams from which the fountain is supplied and thus prevent the escape and leakage of the gas. The recurrence of such a drouth, will, if ever recurring, be at great intervals, and will not probably render the use of oil for a long time necessary.

On another page of the same volume, namely, page 769, we find a communication signed by Lieut. S. Pleasanton and addressed to Hon. Thomas Corwin, secretary of the treasury. The communication bears date June 7, 1851. In it the following passage appears:

We have one lighthouse on Lake Erie, lighted with natural gas, conveyed a distance of two miles in pipes and even here we are obliged to keep oil and lamps, as water frequently collects in the pipes, over which the gas will not pass, and whilst they are taken up and freed from water, oil light has to be used. We have a contract for supplying the natural gas at the annual cost of the oil that would be required if lighted with this material.

The language of these extracts is in both cases somewhat ambiguous, but what the writers evidently meant to say can be clearly made out. The effect of a severe drouth on the gas supply seems to have resulted in a waste of the gas. The main and

natural channel was deserted and numerous insignificant escapes took its place. The return of the water of the stream would shut off the latter, restoring the original flow.

Judge Campbell's gas spring, the one in question, is about three quarters of a mile from the lighthouse (not two miles, as the last document makes it). It occurs in the floor of a little stream called Tupper's creek, and but a few rods back from the lake. The joint lines in the Portage shales are very distinct at this point, appearing as if a slight uplift had been experienced by the shales. In direction they agree with those already described in the bed of Canadaway creek at Fredonia. The two main systems are approximately *northeast-southwest*, and *east-west*. Other directions are also found in subordinate joint lines. The "odorous air," noticed by the old surveyors, is still in evidence. One entering the ravine, either from the lake or the highway, will easily find his way to the escaping gas by its unmistakable odor. The spring was marked at a still earlier day by the French explorers of this region as a *fontaine qui bouille*. At a later date this immediate neighborhood was investigated as a source of salt. A so-called salt well was dug near this point in 1815. It was very shallow and nothing came from this search. The not unwarrantable expectation seems to have gained entrance to the minds of some that where one form of mineral wealth occurs other forms are likely to be found. Drilling at any point in the neighborhood for a few scores of feet would undoubtedly have revealed the presence of salt water.

No effective means for accumulating the gas have ever been employed. Iron pipes are thrust into the crevices of the rock to catch what they can. At the present time the supply is very scant, not enough for even a single fire. In the days when the lighthouse was supplied, wooden pipes (pump logs) were employed to convey the gas. When the harbor and lighthouse were abandoned, an effort was made to secure the gas spring for the service of the village of Westfield. In working toward this result the property changed hands several times. It is not necessary to follow these changes in detail. In 1864 Judge Campbell first sold the property. Among the subsequent owners were David H. Taylor, the Barcelona petroleum co., the First national

bank of Westfield, and the Westfield gas co. (by Dr S. B. Brewer, president). It is now owned by the Phoenix gas and improvement co. of Philadelphia, having been recently purchased from the executors of Dr Brewer's estate. In October 1866, the village corporation gave the right to the gas company to lay mains through the streets for the purpose of supplying public lamps. A two inch iron pipe was laid from the village to the spring about that time and the use of the gas was at once begun. The supply, however, was found inadequate and it soon became necessary for the company to enter on the manufacture of coal gas. This has been continued to the present day, the supply being helped out by the small quantity of natural gas furnished by the well.

About 1865 the Barcelona petroleum co. drilled a well in the neighborhood already described to the depth of a few hundred feet. No oil was found in it, but it yielded a moderate supply of gas. The well was drilled wet and was soon overrun with water, but the gas supply has not entirely ceased even yet. Two or three years since, a measurement of its quantity was made and it was found to be still giving off about 1800 cubic feet a day.

Dr Brewer also drilled a well near the gas works for the purpose of turning the supply into the village line. He struck two gas veins, one at a depth of 500 feet, and the other at 1100 feet, but the production of both was so small that no account was taken of it.

In recent years wells have been drilled in the village to obtain household supplies of light and heat and a number of them have been successful. One of the best instances is found in the experience of Mr Reuben G. Wright, who resides one half mile east of the village center. Mr Wright had seen the result of much of the drilling previously recorded and had concluded that the weak supplies of gas belonging in the shales were permanently discouraged by the heavy body of water that was allowed to lie on them in the process of drilling. In a well that he began 14 years ago, on his own village lot, he cased the water off at 120 feet. He found a small volume of gas at 200 feet and an additional supply at 500 feet. The well was drilled to a depth of 900 feet. The amount of gas was small and the rock pressure feeble, the latter not exceeding three or four pounds. But, after

all, the well yielded gas enough to light his house and to supply the kitchen range with fuel. Encouraged by this experience he drilled two more wells, five or six years since, to add to his supply. These wells he did not carry to a greater depth than 550 and 600 feet. They were very like well no. 1 in all respects and he is now able to supply his house with light and heat, except that for a few months in winter it is necessary to supplement the gas by a coal fire in the furnace.

Several other partial successes have also been gained in this same line. Mr J. G. Apple, an experienced oil operator, has put down a deep well on his property in the village.

In 1894 a test well was drilled on the old paper mill property, a mile or two south of the village. A company was organized by the efforts of a "prospector" named Adams, from Erie, Pa. Among the citizens who took the greatest interest in the test was Mr Herman L. Kent, who has kindly furnished information in regard to the drilling.

It is said that the principal argument of the prospector for the location was drawn from a line connecting Bradford, Pa., with the Canadian gas fields, but this line is a northwest line and Westfield is not on it at all. It is, however, almost a relief to find an "oil expert" adopting a line other than a northeast one. It is probable that gas was looked for in the Medina sandstone, and the facts from Canada were used to support this view. A uniform dip was probably looked for in the strata and the calculation made from that as to the depth at which the Medina would be found.

The drilling was started by 10 persons, each of whom subscribed $200. They contracted with Mr Adams to drill to a depth of 2500 feet at $1 a foot. A company was afterward formed by six of the persons already interested, under the name of the Westfield fuel and light co. Leases were then taken on property that it seemed wise to control. Gas veins were struck in this well at about 1000 feet and also at 1300 feet. At 1500 feet a heavy flow of salt water was encountered, which completely filled the well. The new company proceeded to drill still deeper. An addition of $2000 was raised for this purpose among its members. After several unsuccessful attempts, the well was cased at a depth of 1608 feet. After a little progress below this

point the tools were lost. Some say that they were lost at a depth of 1800 feet, others at a depth of 2000 feet. A one inch pipe brought up the gas that was previously found, and it was kept burning for a long while. Interest in the scheme gradually died out and the owner of the land has lately resumed his right to the property and has removed the derrick.

The Devonian limestone was undoubtedly reached in the drilling, but no record seems to have been kept as to its exact depth. This was really one of the most important facts this well should have been able to supply. It is said that the contractor counted himself within 100 or 200 feet of the Medina sandstone when the drilling tools were lost.

The people of Westfield spent $4000 on this test and nothing resulted from it. The driller recognized two sand rocks in the series penetrated; one at 1000 feet, 30 feet thick, and another at 1300 feet and 20 feet thick. Both proved to be reservoirs of gas. The volume was small but the supply seemed fairly persistent.

The rock pressure of the shale gas is weaker in Westfield than in Portland, to the east, or in Ripley, to the west. The natural escapes of the gas, like the well known one at the lighthouse spring and at other points under the waters of the lake, from which gas is constantly rising, are counted by some an adequate explanation of this low pressure, but it should be remembered that similar vents are found in the other townships named.

d *Ripley.* All the surface rocks of the belt under consideration in Ripley are of Chemung age, the Portage group going under cover on the eastern line of the township. The series consists as largely of shales as those of the townships previously described, albeit they differ somewhat in character and composition from the latter.

Within the last 12 or 15 years this township has developed its gas resources more fully than any other in the county, unless Portland be excepted, and probably no exception is needed even in this case. Wells have been drilled westward to the Pennsylvania border and while they are multiplied at the village center they cover territory several miles to the eastward, and excellent success has been also registered in trials three to four miles south of the lake and thus well up on the rising ground of the hillside.

The following list embraces most of the best known wells. The number is sure to be rapidly multiplied.

Dexter Alfred	Frederick Randall, 7
H. A. Burton	Nelson Randall
B. J. Horton	W. P. Rickenbrod
Bert Johnson	Frank Spencer
Orson Keith	Edward Taylor
Mrs Walter Loomis	D. G. Tennant
George Martin	Theron J. Walker, 5
Alfred Palmer	John Wethy
E. C. Porter	

The general depth of the wells is at least 600 feet. The rock pressures range from 85 pounds downward, but in all the wells that are counted satisfactory it is at least 20 pounds. The figures generally range between 20 and 60 pounds. The gas veins are light, as a rule, but "blowers" are sometimes met with. The first gas is expected at 125 to 130 feet. The best supplies seem to come from the blue shales of the Chemung. A belt of hard black slate is found in the wells 100 to 150 feet in thickness, and about 500 feet below the surface. It belongs to the Portage division. This is a sort of "farewell" rock for the driller of shallow wells. He has learned to depend on the gas veins that are found above this bed. He also finds that wells are safest when separated by a considerable interval. The best experience seems to be in favor of a quarter of a mile, but this interval is impracticable in many instances.

Of the 27 wells named above there is but one failure so far, and this scarcely deserves to be so counted. Its history is as follows: Orson Keith drilled a well for water. He did not find a good vein, but at the depth of 150 feet a considerable volume of gas appeared and he concluded therefore to save the well for this use. For a time its service was entirely satisfactory. But one day it suddenly dropped off like a light blown out. It so happened that at this identical hour 200 feet of water were being removed from one of the Randall wells, three miles distant. The removal of the water may have allowed the gas to rise to a higher level and thus have destroyed Mr Keith's supply. If the Randall well should again be filled with water and the Keith gas should

then return, the demonstration of the connection between the two would be complete.

In the exploration in Ripley Mr Nelson Randall was the pioneer, beginning the work in 1882. He was led to believe that the shales of the township hold a supply of gas by reflecting on an observation he had made many years before while rowing on the lake, a half a mile or so from the shore. He noticed there a bulging surface of the water and on closer examination found that it was due to escaping gas. The gas he found to be inflammable and he properly concluded that it was derived from the underlying rocks. He began at this time to urge his neighbors to unite with him in a test, but failing to interest others he finally undertook the drilling himself in the year above named, 1882. He drilled a well on his own premises, 780 feet in depth. At 230 feet he found a salt water vein and sunk his casing below it. His well yielded a respectable volume of gas and has supplied without interruption since that date two dwellings with all the fuel and light they require. In addition it has maintained a considerable number of lights in other residences.

His neighbors have now followed his example and wells have been considerably multiplied, as the list above given shows. This increase of wells around the village center will undoubtedly affect the production of all before a very long time.

Mr Frederick Randall, son of Nelson Randall, has laid a two inch pipe through the village streets and has attached to it seven wells, the farthest of which is about two miles to the westward. From this line he supplies a number of households with fuel and light. As the number of wells attached to the line is increased the gas supply becomes more satisfactory. The irregularities of supply that result in the use of a single well disappear when several wells are connected. In the village of Northeast, Pa., in the next township west, not less than 14 wells are connected with a single line and great advantage results from this equalization of flow.

Dr D. G. Tennant, living at the village center, obtained gas for his house for a number of years from the well of his next neighbor, who had a surplus. But several years ago he concluded to drill a well for himself. Since that time no other fuel or light

has been brought into his house and he is also able to supply one of his neighbors with light. No signs of exhaustion appear in the supply thus far. The original rock pressure was 24 to 30 pounds. Under winter use it declines somewhat, but the summers have so far seemed to restore it. The well is 670 feet deep and is cased with five and five eighths inch casing to a depth of 150 feet.

Mr H. A. Burton drilled a well in 1896. The drill passed through 550 feet of blue shale, and then struck the black band, which proved to be about 100 feet in thickness. At 701 feet a "blower" of gas was struck, which was very noisy for a few days. Its roar could be heard several miles away. Its pressure at the time exceeded 100 pounds to the inch, but it soon fell to 40 and finally to 25 pounds. Fearing lest the two veins of unequal pressure might interfere with each other, the owner separated them, bringing them up by different pipes, both of which are under control. He has used thus far, only the gas of the upper vein. The supply from this source has proved adequate for three households in the winter and for five in summer. The lower vein has a pressure of 20 to 24 pounds. There seems no reason to believe that the well would be endangered by its utilization at the present time in connection with the upper vein.

In the fall of 1897 Mr George Martin drilled a well for gas on his premises which proved successful. It furnished a good supply of fuel for his house. An examination of the well a few months after it was finished revealed the presence of oil in it in considerable quantity. As usual, the oil is of lubricating character and apparently of very good quality. The quantity in such cases frequently amounts to 15 or 20 barrels.

The gas supply from the shales continues along the lake shore border for 175 miles beyond the western boundary of New York. The shale formation extends with unbroken continuity from Chautauqua county westward through Erie county, Pa., and through Ashtabula, Lake, Cuyahoga and Lorain counties, O., terminating at Huron, O. Throughout its entire extent it gives rise to the kinds and conditions of gas production that have been described in the preceding pages. Hundreds of wells have been drilled throughout the portions of the belt here named and the number is being constantly multiplied. There has been

a large development in Northeast, Pa. during the last 20 years. Wells have been drilled here by the score and in still larger numbers at Erie, a few miles farther west. Within the city limits of Erie the gas of the underlying rocks has been reduced to incipient exhaustion by the number and close proximity of the wells put down.

In Ohio, tests have been made in every county of the lake shore belt. In the thriving villages along the line many wells have been drilled and the gas has been utilized in each to the value of thousands of dollars, annually, as counted by the fuel it displaces.

Origin of the gas.

That the gas of the shale belt is derived from petroleum stored in the same rock series seems highly probable. There is no difficulty as to the storage of the petroleum. The clays which constitute a large percentage of the shales have a natural affinity for mineral oils, absorbing and retaining them indefinitely. That petroleum is present in the series is proved not so much by the pockets of it containing a few gallons or a few barrels, as the case may be, that are occasionally reached in the process of drilling, as by its universal diffusion through the substance of the shales. In many instances every fragment of the shale, blue or black, brought up from a well, discloses the presence of petroleum to the senses of both smell and taste. The percentage is small, but the total amount of petroleum is considerable. A few years since an examination was made of drillings taken from 1000 feet below the surface at North Kingsville, Ashtabula co. O. The petroleum was extracted by treating the shale fragments with bisulphid of carbon, after they had been reduced to as fine a state of division as possible in an agate mortar. The result was the demonstration of the presence of at least one tenth of 1% of petroleum, *as such*, in the shales. Now if the series of 1000 feet is fairly represented by this determination, what amount of petroleum does it contain? The figures stand for a layer of petroleum one foot thick. This would amount to more than 328,000 gallons to the acre.

That petroleum gives rise to gas is a matter of common observation, and therefore the only question with which we are con-

cerned relates to the origin of the petroleum. If we can determine its history we can learn also the history of the gas that is now found there. That the latter could arise by destructive distillation of the organic matter of the shales is certain. Even the number of gallons of oil to the ton that those portions of the series richest in organic matter can furnish has been determined. It is entirely conceivable that these stocks of bituminous matter may all be needed in the ages to come and that the distillation of the shales may be carried on in the future on a large scale for the purpose of securing these sources of light and heat, but there is no sound reason for believing that any process of distillation is now going on in the strata. The petroleum and gas are found alike in all the varieties of shale, in the blue beds as well as in the black. The preservation of the petroleum, if it took its origin when the organic matter buried in the shale was fresh, presents no difficulty. Petroleum, when sealed in the strata, is a permanent substance, as durable, for aught we know, as coal. No reason can be given why it should not last, as coal does, through a dozen geologic periods. In the region that has now been described the shale is covered with a comparatively thin deposit of drift and in the beds of the larger streams and also in many of the smaller streams it is not covered at all, or, with only a shallow depth of water.

It is in these last named localities that all the natural gas springs of the district are found, but there is no reason to believe that there is any more gas in the particular areas which the accident of drainage has laid bare, than in the territory at large. At the points named, there has been an open way for the escape of gas, but undoubtedly had the valleys been established elsewhere the phenomena would have been repeated.

Another fact that points to the universal diffusion of gas throughout the shales, is the discovery of successful wells in and around every considerable village of the belt. At these village centers there is wealth enough to multiply tests and at all of them gas is found in greater or less quantity. If the villages had been located elsewhere the results would have been the same.

It may be asked why the presence of gas is restricted to a single district as the lake shore belt. As the shales pass under cover to the southward they retain, without doubt, their gaseous

contents, but as soon as we go back from the belt under consideration the depth of the wells must be increased and the additional trouble and expense of taking care of the water veins that are found in the descent is greatly increased. The small gas veins that are due in the lower horizons can no longer make anything like an adequate return for the necessary expenditure, even when the wells would be counted ordinarily successful if drilled in shale territory.

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PETROLEUM AND NATURAL GAS

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EDWARD ORTON, LL.D.

ALBANY

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CONTENTS

Maps

NOTE

The results here given are of investigations by Prof. Orton carried on during the season of 1897 at the instance of the late Prof. James Hall, state geologist and paleontologist, and were communicated with the annual report of that year; but it has since been judged wise, in view of the far-reaching importance of this paper and in order to secure its wider diffusion, to issue it separately as a museum bulletin. The paper is therefore appended to the museum report for 1899.

In references, volume and page numbers are separated by a colon; e. g. 16: 467 means vol. 16, p. 467.

JOHN M. CLARKE

All the facts bearing on these points seem intelligible and rational. They are in accord with the teachings of physics and thus are what we should naturally expect to find in this field.

The principal structural features to which allusion has been made, are commonly known as anticlines, synclines and monoclines. The first of these terms is applied to a roof-shaped arrangement of the strata of a district, in which they decline in opposite directions from a given line called the axis. Sometimes the descent on the opposite sides is equal in amount, but more frequently it is unequal. The axis can generally be followed for a few miles in an approximately straight line, but in many cases its elevation is gradually lost. From the point where it thus disappears, it is quite likely to rise again in the same general direction and at perhaps the same elevation that it originally had. Of course, in such cases, all the fragments are counted as a single axis. Wherever a well-defined axis is found, one or more similar lines of structure are very likely to occur, approximately parallel to the first.

A syncline is a form of arrangement of the strata exactly opposite to the anticline already described. The strata are bent into a trough, instead of into a ridge. All the statements as to the amount and direction of the descent of the different sides that have just been made as to anticlines are to be applied to synclines, with the proper, i. e. reversed, qualifications. In a word, a syncline is the normal complement of an anticline, and when two parallel anticlines occur, the space intervening between them is necessarily occupied by a syncline.

A monocline is in effect an incomplete anticline or syncline. A stratum descending from an approximately horizontal position at a certain level to a lower level regains the original horizontal position after making the descent. It is as if nature began to build an anticline or syncline and was not able to finish it. Monoclines are of much less frequent occurrence than anticlines and synclines.

All these forms of structure are necessarily effected in the differentiation of the contents of a porous stratum. The water, which has been named as one of the three principal elements

contained in such strata, is in most instances saline. With respect to water found at a depth of 500 feet or more, the presumption in many parts of the world is that it is saline. Compounds of soda and potash are widely diffused in the crust and many of them are very soluble and are gathered, accordingly, in underground water. Where the arrangement of the rocks is such that outflow occurs, the soluble compounds will, in the course of time, have all been carried out, and the outflowing water may at last have a high degree of purity. But, in multitudes of instances, the porous strata are so folded that the water of large portions has no access to the surface. When the drill reaches such areas, concentrated brines are often found. Saline water is always heavier than fresh water. It is not uncommon to find these deep waters increased in gravity by one tenth beyond the proportions of pure water. It goes without saying, therefore, that the synclines of the porous rocks, would be occupied by these heavy waters, and it is equally obvious that all the oil will rise to the sides and summits of the arches unless gas accompanies the oil, in which case, the highest level will necessarily be occupied by the latter.

The great development of anticlines and synclines is to be found in mountain regions, and here they are shown in their most striking forms. Parts of the great Appalachian system afford the most complete exhibition of these types of structure that is known in the world, though the Jura mountains of western Europe also furnish admirable examples of folded rock series. It is not in mountain regions, however, where he that runs can read the arches, the elements that constitute them, their dips and their directions, that accumulations of petroleum are to be looked for. When the rocks are folded into great arches that constitute the principal scenic features of the regions which they occupy, they have not escaped fracture at their summits. Faulting has also taken place in numerous instances along their axes, and by these two agencies, namely, fractures and faults, great accumulations of oil and gas have been made impossible. Such fractures give rise to a slow escape of oil, gas or mineral water, the latter often being characterized by temperatures above the nor-

mal. These prolonged escapes of gas and oil constitute most of the so-called "surface indications" of petroleum.

The system of arches and folds above named, that find their chief development in mountain regions, and to which, in fact, the mountains mainly owe their origin, are the results of the contraction of the crust of the earth, apparently due to its cooling. In the Appalachian region of Pennsylvania, Claypole has calculated that the shortening in of the original crust has amounted to 88 miles out of 153 miles, the latter having been reduced to 65 miles. Heim has calculated that an original extent of 203 miles in the Alps has been reduced by folding and crumpling to 130 miles. The arches seem to have resulted from lateral pressure exerted from the side of the ocean. Their axes are approximately parallel to the ocean boundary. Their slopes are gentle on the southeast side and much sharper on the northwest. The strongest folds, as a rule, lie farthest to the eastward. Certainly they diminish in both hight and dip as they are followed westward. In western Pennsylvania, for example, the folds are so reduced that they do not necessarily form the uplands of the region. They can be followed only by determining the elevation of some well-marked bed or stratum, as a seam of coal or sheet of limestone, or some persistent bed of red or blue rock, the peculiarities or the composition of which are well known. By such facts, the reality of the arch is demonstrated and their directions and angles of pitch can be determined.

All the valuable accumulations of petroleum and its derivative, natural gas, in Pennsylvania, are confined to these flattened and dying arches, the slopes of which seldom exceed two or three degrees, and which generally need to be read in minutes instead of degrees. No accumulations are known where the arches show angles of descent of five or 10 degrees or more. It would seem that the strata were cracked in the bending, thus allowing the escape of all mobile substances inclosed in the porous rocks of the series.

Following the effects of the Appalachian revolution still farther westward, we come to the still feebler arches and monoclines of Ohio. Numerous cases have been found during the last few years in which the elevations of even the summits of the

arches have not been found sufficient to effect a separation of the petroliferous substances and the salt water. In the "Big Indian" oil field of Monroe county, Ohio, many cases have occurred in which three or four barrels of salt water are raised by the pumps for every barrel of oil. The latter is, however, frequently produced in amounts of hundreds of barrels in a day.

The best defined monocline known is the Macksburg oil field of Noble and Washington counties, Ohio. In this case it has been demonstrated that the Berea grit has been checked in its uniform descent to the southeastward, at the rate of 20′ or 30′ of a degree and that it lies nearly horizontal for the space of one mile. This horizontal portion has proved available as a storehouse of oil and gas, and a petroliferous production of considerable importance is distinctly referred to this structure, with gas on its western boundary and salt water on the east. We owe the determination of this monocline and the general facts of its productive power, to F. E. Minshall, of Marietta.

Coming back to New York, we find that it was invaded by the Appalachian revolution with its mountain-making forces in very much the same way that western Pennsylvania and eastern Ohio were affected. Through the southern counties of the state, low arches are produced, which lack the force necessary to make them recognizable as features of the present surface relief, but which, as exploration has proved, were ample for the separation of the oil and salt water that were tributary to its porous strata. All the extensions of the great Bradford oil fields into Cattaraugus and Allegany counties are examples. Of these the "Rixburg gas streak" is one of the best.

But while the eastern side of the continent owes to the Appalachian revolution the great features of its relief, it has not been limited to the orogenic activities of this period. Contraction and necessary readjustments of the crust were certainly in operation long before the close of paleozoic time, and the earliest formed strata were left in an uneven condition. The steady growth of the continent from the Canadian protaxis southward is responsible for structural facts of great importance, specially for the prevailing southerly dip that affects the entire state and that

contributes so much to the completeness of the geologic column of New York.

In these previous movements of the crust, more or less relief was given to the land surface or sea floors of the times in which they occurred, and many low arches and synclines resulted in this way; but no prevailing direction is thus far found in any of these ancient structures, aside from this southerly dip already named.

It is not counted necessary in a paper designed specially for the general reader, to furnish proof of the statements already made as to the order of arrangement of the several substances contained in porous rocks. It is enough to say that the facts from every oil field fall into line in support of these statements. Moreover they harmonize so well with the teachings of physics that they soon come to be counted necessary truths and no grounds are apparent from which attacks can be directed against them. Even the disposition to make such attacks seems to have passed away.

The Trenton limestone field or northwestern Ohio, one of the latest oil and gas fields to be exploited, furnishes the most satisfactory and conclusive proofs on all these points. Five or six feet of relief have proved ample to keep gas wells dry for days and weeks, and wells drilled solely for gas and operated as such, have been slowly turned into highly productive oil wells, and, in multitudes of cases, have, at a later date, been overrun with salt water.

Section 2

Origin of petroleum, natural gas, maltha and asphalt

The readers of this paper will expect some attempt to answer the questions that human curiosity everywhere raises as to the origin of the bituminous series. The series has long been known to man. We find mention of it in the oldest records and traditions of the race, but its real value and importance have been mainly developed in the present century and very largely in our own day.

The bituminous series contains at least four well-marked elements; namely, natural gas, petroleum, maltha or mineral tar,

asphalt. The probable order of their derivation is not the order given above. From petroleum as an original center the other three substances are seen to be easily derivable by natural and familiar processes. From deep-stored oil when brought to day natural gas is always given off. By the removal of the gaseous hydrocarbons, the gravity of the petroleum is increased and the process of oxidation sets in, the effect of which is to darken the oil and still further reduce its gravity. We advance but a little way along this line before we begin to withdraw the name of petroleum from the dark and viscous liquid that we find resulting and give the substance the more appropriate designation of mineral tar. It is also called maltha, which is an ancient and somewhat technical designation.

Now, if the mineral tar is still further exposed and oxidized, it loses its liquidity altogether and hardens into a black solid, dull or shining, as the case may be, called asphalt.

Further, the petroleum from which the latter products are derived has itself a wide range in gravity. Some examples of it run as light as 55° B. while in other cases heavy oils of less than 20° B. occur. In the latter case it is always possible to explain the facts by the loss of the volatile elements as they approach the surface. All shallow oils, under which designation are included the occurrences of petroleum within one or two hundred feet of the surface, are heavy. Some of them are too viscous to flow freely and are well adapted in the natural state to lubricating purposes.

Not only does the fact that gas, maltha and asphalt are easily derived from petroleum point to the latter as the original substance, but the facts as to the chemical composition of oil and gas respectively lead to the same conclusion. Natural gas consists essentially of light carburetted hydrogen (CH), while petroleum has a much more complex composition. The simplicity of the former points to it as the derived substance. It is therefore necessary to account for the origin of petroleum only. All its derivatives will be explained under the same head.

The subject has proved a tempting one for consideration and as the economic importance of the series has increased it has commanded more and more attention, till there is at the present day a voluminous literature devoted to it. In regard to the

question, from what source and by what process did petroleum originate, we find many and discordant answers. A distinguished German geologist, Prof. C. F. Zincken, of Leipzig, says that for this subject we can well adopt the inscription placed over a meteorite that fell, centuries ago in Germany. *Multi multa; omnes aliquid; nemo satis.* These words can be thus translated: "Many men say many things; everyone says something; nobody gives a satisfactory account." When we come to analyze the various answers as to the origin of petroleum the case is not as discouraging as this statement would lead us to conclude. There is one point of vital importance in the discussion, and in regard to this it may now be said that there is substantially an agreement among all geologists who have earned the right to speak on the question; and, what is equally to be desired, there is a rapidly growing accord among chemists who are prepared to apply first-hand knowledge to the discussion of the subject. The vital point above referred to is the question whether petroleum is the product of chemical affinity, exerted on inorganic matter, or whether it is a result of the transformation of substances that have been built up under the agency of life. It is the latter line of answers that has come to be universally accepted by geologists and it now looks as if there would soon be equal unanimity among chemists in regard to the same point.

Section 3

Theories of origin

a *Theory of inorganic origin*

It has been claimed by a number of chemists, some of whom hold high rank in the scientific world, that the several members of the bituminous series can be referred to a purely mineral origin. There are several phases of this doctrine. One of them seems to imply that the elements, carbon and hydrogen, are combined in the interior of the earth through the agency of the high temperatures prevailing there. This phase of the doctrine matches to but few facts in nature and does not appear to be making progress.

The most widely accepted theories as to the inorganic origin of petroleum are those that refer it to certain definite chemical

reactions. Two among these theories have obtained a wide circulation by reason of the high rank of their authors, but they can not be said to have gained an equally wide acceptance.

In 1866 Berthelot, professor of chemistry in the college of France, and distinguished by remarkable and epoch-making discoveries in organic chemistry, particularly as to the composition of alcohols and sugars and by the discovery of acetylene, advanced the theory that the interior of the earth contains free alkali metals (sodium and potassium) and that these elements, when acted on by carbonic acid or carbonates at a high temperature would form carbids of these metals, which, by the action of water, would form hydrocarbons analagous to those found in petroleum. In short, he proposed the theory that both liquids and gaseous hydrocarbons of the bituminous series would result if meteoric water carrying carbonic acid or earthy carbonates in solution should reach by infiltration the metallic masses above named at a white heat and under high pressure. The chemical reactions invoked under the conditions named are undoubtedly sound, and the bituminous series would unquestionably result if these conditions should be met. The recent production of calcium carbid by the electric furnace on a commercial scale and its common use in the production of acetylene gas as an illuminant have made the process familiar and have given to it an air of reality that it never before possessed.

The theory of Mendeljeff, the eminent Russian chemist, is founded on altogether similar lines, but is relieved from some of the glaring improbabilities of Berthelot's hypothesis. It was first announced in 1877 and has been revamped and restated by the author during the present decade. Mendeljeff is the author of one of the most remarkable generalizations ever made in the science of chemistry. It is known as the *periodic law*, and has given to the science the ability of predicting future discoveries, similar to that so long possessed by astronomy, and which is recognized by all as the crowning proof that a science has reached its perfect, though not necessarily, its completed stage. There is no higher name in chemistry today than that of Mendeljeff.

His theory in regard to petroleum formation is briefly this. He supposes the interior of the earth to contain large masses of

metallic iron and counts the formation of meteorites confirmatory of this conclusion. He also considers the specific gravity of the earth, which is 5.5 against 2.5 for its surface rocks as rendering it certain that the interior contains substances heavier than ordinary rocks. In these interior masses of metallic iron he supposes more or less carbid of iron to exist as in meteorites. Carbids of iron would also be formed by the descent of carbonated water as in Berthelot's theory. Water infiltrating through fissures in the crust would be turned into steam at the depth supposed, and attacking the carbid of iron, would give rise to the petroleum compounds. The steam already invoked exerts pressure enough to force the petroleum vapors back toward the surface till they would become condensed by cooling and would be stored in all porous rocks capable of containing them. This is by far the most widely known and powerfully supported theory of the inorganic origin of bitumens. Mendeljeff expresses himself as satisfied with it and declares that petroleum is as truly a product of chemical affinity as a veinstone or an ore. This theory seems to promise a continual production and thus an unfailing supply of oil and gas and is sure to be welcomed in every field that is entering on its exploitation.

In like manner chemists who have given but little attention to the geologic facts connected with oil and gas further than that they occur beneath the surface, finding a theory at hand explaining the origin of these interesting substances on sound chemical possibilities, have naturally turned to this explanation with prejudice in its favor. Occasionally, also, a geologist has been misled by it, but, little by little, as the far-fetched and highly improbable assumptions of this theory have come to be considered and as a far simpler and more probable account of the origin of bitumens is at hand, Mendeljeff's speculations have lost standing with men of a practical turn, both chemists and geologists, till of late years no one has been found to champion it as if he believed it. To geologists, indeed, it sounds like an echo from the 18th century. It takes its place with the "cloud-capped towers and gorgeous palaces" of the speculations of Werner's time, 100 years ago.

The latest vigorous defense of the theory in question was made in 1889 by Mr William Anderson, at that time president of the

mechanical section of the British association for the advancement of science, but this defense revealed such profound and surprising ignorance and misconception of the geologic facts as to the occurrence of petroleum that it necessarily lost weight with all who are familiar with these facts, and must have weakened rather than strengthened the theory itself. [For an examination of this defense see *Geology of Ohio, Annual report*, 1890, p. 61.] A weighty consideration in this connection is found in the geologic distribution of petroleum and its derivatives.

We can roughly divide the rocks of the earth's crust into two great series, namely, those in which organic remains are more or less abundant, and those in which no traces of life are found. Their absence in the latter case may be accounted for either because life had not been introduced at the time of their formation, or by reason of metamorphic changes that have supervened since their origin, by which all such traces, if ever present, have been removed. In the last named division, neither petroleum nor any of its derivatives is ever found, and all its occurrences are confined to the fossiliferous division. While Archaean rocks do not cover as large an area as the vast series formed in the ages of life, they are by no means insignificant in extent. 2,000,000 square miles in one continuous body are referred to this division in the Canadian protaxis alone, and in the other continental masses a like distribution is recognized.

A single exception as to the absence of the entire petroliferous series from the Archaean rocks must, however, be made. In a few localities in the uppermost division of this series in Ontario, considerable deposits of an asphalt-like material, thoroughly compressed and hardened, are found. It can be made to burn only under the most favorable conditions. That the substance originated in petroleum is highly probable, but it is to be borne in mind that the rocks in which it is contained bear unmistakable evidences of having been originally stratified. If stratified they may have contained the remains of life. But aside from this and probably a few other exceptional cases, petroleum and all the substances derived from it are wholly wanting in the Archaean rocks. There is not an oil field in the world in the rocks of this age.

This fact alone constitutes a weighty argument against the hypotheses already presented. If the real centers at which petroleum originated are to be found in the primeval crust, according to Berthelot and Mendeljeff, the carbonated water essential to the process would certainly have a shorter course in reaching these masses of uncombined elements or metallic carbids by descending through the uncovered Archaean than by going down through thousands of feet of the stratified and fossiliferous rocks that overlie this formation.

Another fact that bears against the theory named above is the steady and notable increase in bituminous products that has seemed to go forward throughout geologic history. Their maximum production was apparently reached in Tertiary time. But the internal heat of the earth, which is an important factor in the theories named has been gradually reduced during these same ages. The results are thus directly contradictory to those required by Berthelot's and Mendeljeff's assumptions.

We come, therefore, to another line of explanations.

b *Origin from organic sources*

The reference of petroleum to an organic source stands in very different relation to familiar facts from the theories already reviewed. Petroleum is a combustible substance and every other substance that we know in nature that can be burned is of organic origin. Moreover we can produce artificially from vegetable and animal substances gaseous and liquid compounds that are closely allied to the bituminous series or even identical with them. The manufacture of illuminating gas furnishes a case in point. We obtain by this process not only the volatile combustible, but the liquid coal tar as well, that is closely analogous to some of the petroleum compounds. Illuminating gas is ordinarily manufactured from bituminous coal, but we can use all varieties of vegetable and animal substances for the same purpose. Even street sweepings and the ordinary refuse of a city have been by a patented process applied to the same manufacture. The occurrence of gas at the bottoms of ponds, produced from decaying leaves, or in boulder clay, from buried vegetation, are phenomena of common note.

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ON

INJURIOUS AND OTHER INSECTS

OF THE

STATE OF NEW YORK

1899

BY

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State entomologist

ALBANY
UNIVERSITY OF THE STATE OF NEW YORK
1900

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15TH REPORT

OF THE

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OFFICE OF STATE ENTOMOLOGIST
Albany, 14 Oct. 1899

To the Regents of the University of the State of New York

GENTLEMEN: I have the honor of presenting herewith my report on the injurious and other insects of the state of New York for the year ending Oct. 14, 1899.

General entomologic features. Excessive injuries by the forest tent caterpillar, Clisiocampa disstria Hübn. were even more pronounced in many localities the present season than last year. On account of this insect's appearing in force on many maples adorning roadsides, the outbreak attracted more than the usual amount of attention and induced vigorous efforts in certain communities to prevent serious injuries. The village authorities of Glens Falls, Saratoga Springs, Herkimer and a few other places were obliged to fight the pest at public expense. The closely related apple tree tent caterpillar, Clisiocampa americana Fabr. was unusually destructive, specially in the western part of the state. The appearance of a brood of 17 year cicadas, Cicada septendecim Linn. in the Cayuga lake region excited considerable interest. Some attention, in an incidental way, has been given to the distribution of certain insects believed to be limited to the upper austral life zone. One of the most important results of this work was to show that the 12 spotted asparagus beetle, Crioceris 12-punctata Linn. was much more generally distributed throughout the state than had been supposed. A personal examination of sugar maples in Syracuse, Batavia and Leroy showed that the sugar maple borer, Plagionotus speciosus Say, had

been very destructive, specially in the latter place. A striking instance of the influence of the press was seen in the great interest manifested last summer in the so-called kissing bug, Opsicoetus personatus Linn. a species which had hitherto attracted very little attention.

Elm leaf beetle. The serious injuries inflicted the last few years by this imported insect, Galerucella luteola Müll. indicated the desirability of educating the public more fully concerning the pest. A lecture, describing local conditions and giving the methods of fighting shade tree pests, with special reference to this insect, was delivered before the Troy scientific association March 6. Substantially the same matter was presented before the Albany institute April 4. In addition, a number of short articles giving timely notice of methods of procedure against shade tree pests were published in local papers. Though the city authorities of Troy made no provision for the general spraying of trees along the streets and in the parks, much was accomplished at private expense. W. H. Gordinier, who the preceding season had operated a power spraying outfit, prepared a second and found more calls for his services than he could meet. Wherever spraying was timely and thorough, most excellent results were obtained. It will be found that in infested localities where no provision has been made for general spraying along the streets and in parks, many valuable trees will be sacrificed. In all work against the elm leaf beetle, it has been found necessary to emphasize again and again the supreme importance of timely and thorough work. This is specially true since the public frequently judges of the value of spraying from that which was done by careless or ignorant persons.

Office work. The routine office work has been much heavier than last year. An unusually large number of insects have been received with requests for information concerning them. The inspection of nurseries conducted under the supervision of the commissioner of agriculture has led to frequent calls on this office for the identification of scale and other insects. The entomologist has also been requested to cooperate with that department in some experimental work and has been called on to give advice and to revise a folder giving the formulas for insecticides. The demand for popular information through the agricultural press has been very gratifying and indicates a hearty appreciation of this work among farmers. The number of letters and postal cards written has been greater than in any previous year and amounts to 1559.

The prosecution of certain lines of field work and investigation has been seriously curtailed by the large amount of proof reading incident to carrying through the press in the summer a large general index of 200

pages embracing (as estimated) 38,000 references. Though this has required an enormous amount of labor, it is believed that the office itself will be amply repaid for the work done in the additional facilities for referring to previous reports.

The office is fortunate in possessing two valuable assistants. C. S. Banks, of Oswego N. Y. was graduated from the Oswego normal school in 1896 and has taken two short courses in entomology at Cornell university. In adddition he has studied and collected insects on his own account for some years. Miss Margaret F. Boynton, of Lockport N. Y. was graduated with honors from Cornell university in 1895, held a graduate scholarship there in science during the college year 1896-97 and since then has done considerable work in natural history.

Pressure of other work has prevented the preparation of the usual detailed notices of injurious insects observed during the year. The scientific results of the season, aside from certain notes submitted herewith, will be presented at some future time.

Publications. An effort has been made to send out timely information through the press, so as to be of service in preventing injury from insect attacks. This is of more importance than at first appears, because many complaints are received when it is too late to apply remedial measures. A number of circular letters were prepared and sent to papers in localities where the insects noticed were likely to cause damage. Remedial measures were indicated in this way for the following insects: white-marked tussock moth, *Notolophus leucostigma* Abb. & Sm., elm leaf beetle, *Galerucella luteola* Müll., forest tent caterpillar, *Clisiocampa disstria* Hübn. and the 17 year cicada, *Cicada septendecim* Linn. Two short bulletins were issued in April and May, one designed to encourage the study of insects and to aid voluntary observers and the other to give popular instructions for controlling insect depredations on shade trees. A popular account of several of the most important shade tree insects, illustrated by three colored plates, has been prepared for the report of the fisheries, forest and game commissioners. A list of the publications of the entomologist, 95 in number, is given as heretofore.

Collection of insects. The additions to the state collection of insects have been greater than in any preceding year. My assistant, Mr Banks, has spent considerable time in the field collecting forms specially desired. The contributions of insects from correspondents have been larger than heretofore. The additions made by the office force have

been mainly to the biologic collection, as it was felt that special attention to this feature was necessary. Some of the newly acquired material has been arranged to form the exhibit noticed below. As there was no assistant last winter, it was impossible to begin the much needed arranging and classifying of the insects in the state collection, and the numerous duties incident to the period of greatest insect activity prevented such work in the summer. A case containing 68 trays, made after the same plans as those used in the United States national museum, has been provided, together with additional shelving, and with this increased space at disposal, it is planned to get the collection in much better shape the coming winter.

Plans have been completed for adding to the state collection and at the same time increasing the interest in insect life. Students in regents high schools are allowed a nominal sum for insects sent to the state entomologist in good condition, provided a certificate of actual attendance is previously filed with him. As the plan was not made public till September 1, it is too early to report results.

The private collection of the late Dr J. A. Lintner is still in the office and should be bought for the museum, as it is composed largely of native forms from all parts of the state, besides containing many unique specimens.

Division library. The reference library of the division is sadly lacking in many valuable works, though every effort has been made to supply deficiencies. Were it not that the entomologist has enjoyed the use of the private library of his predecessor, the literature at his command would have been very limited. Some provision should be made to supply this vital deficiency. As Dr Lintner's library was built up largely to supplement the volumes possessed by the state, its purchase is most urgently recommended.

Exhibition of insects. In my previous report the exhibition of small insect collections at fairs, grange meetings and other places where farmers assemble was recommended. As a beginning, a collection representing one or more of the various stages of over 100 of the more important injurious and beneficial insects was prepared and placed on exhibition at the state fair at Syracuse and also at the Oswego county fair. A catalogue giving briefly the leading characteristics of the various species and outlining the treatment of those injurious, was distributed. The interest manifested indicates the desirability of making adequate provision not only for similar exhibitions at state and county fairs, institutes

and other gatherings, but also for a complete collection of the injurious and beneficial insects, which should be maintained as one of the permanent exhibits of the museum. Such collections are educators of the greatest value to the agriculturist, who in no better manner can become familiar with the habits of the important insect pests he must fight. A more detailed account of the exhibit at Syracuse will be found on subsequent pages.

Voluntary observers. A corps of voluntary observers in entomology was established for the purpose of bringing the entomologist into closer relations with the public and also to facilitate the gathering of information; for the reception of weekly reports during the growing season from all sections of the state could but result in bringing together many important facts. The value of the service will be enhanced as the work continues, for many of the previous records concerning some of our more common injurious insects are remarkable either for their scarcity or vagueness. There are now 43 observers, representing 39 counties. Most of the reports submitted are valuable, while a few could hardly be improved on. As the purpose of the service becomes better understood, it is expected that more effective work will be accomplished. A summary of the work of this organization will be found on subsequent pages.

Entomological society of Albany. The organization of a local entomologic society, though in no way officially connected with the division, is worthy of mention, because it is an effort to quicken a home interest in this important branch of natural history. The society was organized May 19, now has an active membership of 23, and gives promise of awaking considerable interest in insect life. In order to encourage this movement, the facilities of the office are placed at the disposal of the society and its members, provided there is no interference with official duties.

Acknowledgments. The thanks of the entomologist for aid rendered are due to other workers along the same lines, particularly to those connected with the United States department of agriculture, who have most obligingly complied with every request. The hearty support and encouragement given by the regents have done much to make the work of the year successful, and it is with the greatest pleasure that I acknowledge the same.

Respectfully submitted

EPHRAIM PORTER FELT

State entomologist

NOTES ON INJURIOUS INSECTS FOR 1899

Several insects have appeared in unusual numbers or have attacked crops not previously affected by them. The unusual abundance of the milkweed butterfly, Anosia plexippus Linn. may be mentioned, and of the harvest fly, Cicada tibicen Linn. The destructive work on sugar beets of the red-headed flea beetle, Systena frontalis Foerst. is noteworthy. The beetles had evidently bred beside a large field in Syracuse N. Y. where they were found in great numbers at the time of my visit to the locality, and from there had invaded the patch, giving it a brownish, ragged appearance. The pest was quickly conquered by spraying with paris green. In a few places in the central parts of the state, American elms suffered severely from the larvae of a flea beetle, Disonycha triangularis Say, which devoured the lower epidermis of the leaves. In August the foliage of these trees presented the dried, brown appearance so familiar in the Hudson river valley in connection with the attacks of the imported elm leaf beetle, Galerucella luteola Müll. The pea crop on Long Island was ruined in places by the attacks of a plant louse, since named Nectarophora destructor Johns. One grower lost 20 acres and another 14 through the work of this pest. Another insect which attracted much notice last summer was the so-called kissing bug, which in this state must be considered the masked bed bug hunter, Opsicoetus personatus Linn. Undoubtedly some persons were bitten by this insect, but many of the newspaper stories rested on a very slender foundation in fact, at least so far as the identity of the creature was concerned.

Raspberry saw fly. The pale green, spiny larvae of this insect, Monophadnoides rubi Harr. were received from Newark, Wayne co. with the statement by C. H. Stuart that they had been very injurious to raspberry plants. He wrote as follows: "The leaves of the infested patch looked today [June 10] like those of a badly infested currant bush. There is hardly a leaf in the field without several holes in it, and most of the older leaves are eaten to threads." At Oneida, Madison co. two acres were defoliated by this insect, as I was informed by J. T. Thompson. They had occurred in small numbers the preceding season in the latter locality. The badly eaten raspberry leaves received the latter part of May from Mrs H. E. Robinson, of North Nassau, Rensselaer co. had probably suffered from an attack of the same insect, though no larvae were found on those submitted for examination.

Locust borer (Cyllene robiniae Foerst.) Some half dozen of the pretty beetles belonging to this species were received September 20 from J. H. West of Poughkeepsie N. Y., with the information that they had practically destroyed a very handsome young locust tree, which to within two years had been in excellent condition. The attack was first observed in the early fall of 1897. The trunk, about 6 inches in diameter, was full of holes to within 15 or 20 feet from the ground and "the outside was covered with these bugs to the top." The tree was treated with benzine and washed several times with a stream from a hose. Last year no insects were noticed, but for the past few weeks the beetles have been very abundant. Several limbs and one of the two main trunks were so badly riddled with burrows that they broke with their own weight. A portion of the infested tree, which came to hand later, showed that the above account was not an exaggerated one. The interior of the branch, one of the best on the tree, was badly honeycombed with burrows and here and there, where the beetles had emerged, the bark was badly undermined and perforated. The tree had evidently been oviposited on freely, as irregular clusters of ovoid white eggs, about $\frac{1}{8}$ inch long and $\frac{1}{24}$ inch in diameter, were found in cavities beside some burrows, and single eggs, tucked in longitudinal crevices of the young bark, were numerous.

Elm leaf beetle. In Albany, Troy and vicinity this pest, Galerucella luteola Müll. has been as injurious as in preceding years, except where it has been controlled by spraying with arsenites. As it has established itself in force at Worcester Mass. and in a number of towns in the same county, all of which are probably within the transition life zone, it is very likely that in the course of time this beetle will make its way over a much larger portion of the state of New York than it has hitherto been supposed the insect could occupy. But I have yet to learn of its establishing itself in territory in this state outside the upper austral life zone, though it probably will, if it can exist in the places named in Massachusetts. In both Albany and Troy large amounts of arsenate of lead have been used with most excellent results, when the applications have been timely and thorough. W. H. Swift & Co.'s prepared paste was used at the rate of 4 pounds to 200 gallons of water. In Troy over 1500 pounds of this insecticide was applied to the trees, and the person using it was highly pleased with the results, specially as the poison was found in the autumn on fallen leaves last sprayed May 22. Probably an equal amount was used in Albany. Troy furnishes an interesting example of what the elm leaf beetle can do. Its ravages there have been

even worse than in Albany, and yet the city authorities did nothing to check it, except some spraying in public parks. The direct result of severe and general injury to the trees was a great demand for spraying apparatus operated by skilled men. One individual fitted up two power spraying outfits of a most approved type, beginning operations with the first last summer and with the second the present season. He has had more work than he could attend to, and it is to be presumed that he has lost no money in running them.

Asparagus beetles (Crioceris asparagi, Linn., C. 12-punctata Linn.) It has been my conviction for some time that the common asparagus beetle was more generally distributed in the state than is shown by previous records. The attention of voluntary observers was called to this insect and specimens were received from several localities. Last spring the 12 spotted form was taken in two or three places about Albany, and this, in connection with its occurrence near Rochester for a number of years, its discovery near Buffalo last year and at East Amherst and Newark the present season would indicate that this form has also attained quite a general distribution. Personal observations have enabled me to locate both of these insects in several places where they have hitherto been unrecorded. Crioceris asparagi is now known to occur in the following localities: Albany county, Albany, Menands; Dutchess county, Poughkeepsie; Erie county, Buffalo, East Amherst; Essex county, Ticonderoga; Genesee county, Batavia, Leroy; Greene county, Athens, Catskill; Livingston county, Geneseo; Madison county, Lebanon, Oneida; Monroe county, Brighton; Oneida county, Maynard, Vernon, Whitesboro; Onondaga county, Syracuse; Ontario county, Geneva; Orange county, Cornwall, Westpoint; Oswego county, Oswego, Oswego Center; Putnam county, Garrisons; Rensselaer county, Troy; Saratoga county, Mechanicville; Ulster county, Kingston; Wayne county, Clyde, Newark; Yates county, Crosby. Crioceris 12-punctata is known to occur in the following localities: Albany county, Albany; Erie county, Buffalo, East Amherst; Genesee county, Batavia, Leroy; Kings county, Brooklyn; Monroe county, Brighton; Onondaga county, Syracuse; Oswego county, Oswego Center; Queens county, Glendale, Richmond Hill; Tompkins county, Ithaca; Wayne county, Newark; Yates county, Crosby. Dr James Fletcher, entomologist of the Central experimental farm of Canada, informs me that both species of asparagus beetles are abundant in the Niagara district and as far back as Hamilton, Ontario.

The common asparagus beetle is probably well distributed over Long Island and the 12 spotted form occurs there. From the records at hand, it appears probable that the common asparagus beetle has established itself in all sections of the state included in the upper austral life zone. The 12 spotted form has been found in as widely separated localities in the western part of the state as the other species, and it will probably invade all territory now occupied by C. asparagi, if it has not done so to a large extent already. As the presence of C. 12-punctata at Glendale and Richmond Hill for at least four years has been known to L. H. Joutel, who kindly gave me these localities and informed me that it was common about Brooklyn, it is very probable that this species has obtained a rather general distribution over, at least the western end of Long Island. Dr L. O. Howard has lately added to the list of localities the following: Chemung county, Elmira; Monroe county, Penfield; Ontario county, Geneva; Suffolk county, Riverhead.

Willow butterfly. The caterpillars of this species, Euvanessa antiopa Linn. have been objects of more complaints than usual and doubtless were more injurious to elms than they had been for some time. The offenders were members of the first brood and were noticed mostly in early June. At Glens Falls, C. L. Williams reports that the caterpillars were widely distributed over the village and were doing some damage. They were received from Rhoda Thompson of Ballston Spa with the complaint that they were doing considerable injury. From Crosby, Yates co. Cyrus Crosby sent examples and said that they were stripping elms. From Port Jervis came a similar complaint by J. M. Dolph regarding a black caterpillar, probably this species, that was defoliating Carolina poplars. The insect was very abundant in Albany and many caterpillars were killed by persons connected with the public parks. This species was also received from Troy, Sandyhill, Palatine Bridge, Chatham, Binghamton N. Y. and Clinton Mass. In each case the abundance of the caterpillars had attracted the sender's attention. They were undoubtedly more abundant than usual and caused considerable injury in many localities, but as they are gregarious in habit damage done by them is much more apparent than that produced by species which feed singly.

Forest tent caterpillar. The ravages of this insect, Clisiocampa disstria Hübn. probably never excited more interest in this state than during the present season. Not only were large numbers of trees

defoliated in many parts of the state, but the pests were present in force on shade trees in the streets of many villages, and by dropping on passers, crawling under foot, occupying piazzas and sides of houses, brought themselves to the attention of many who would otherwise have been indifferent to their presence. The loss suffered through this pest last summer can never be expressed in exact figures, but, when it is remembered that these caterpillars inflicted severe injuries in about half of the counties in the state, in not a few instances defoliating tracts of many acres in extent, it is seen at once that the total damage inflicted must be enormous. Outbreaks of this insect are more or less local, and usually do not last more than two to four years in a place, hence in some sections the pest was much more injurious than in previous years, while in others it was not as abundant. From Otsego county came as distressing reports as from any place. The following is from a letter by Rev. H. U. Swinnerton, of Cherry Valley: "Stopping trains is not a circumstance to what we have here in the way of stopping things with worms. We would stop the progress of the age, if it got across the way our worms were going." He then proceeds to narrate how, because of the abundance of the caterpillars, the train he was aboard was stalled three times between two stations about eight miles apart. Delaware county appears to have suffered very much, as the pest has been in certain localities for the past two years. H. E. Wilford of Andes writes: "We are being devoured . . . by maple worms. Can you give us any assistance?" Dr J. N. Wright of Grand Gorge informed me that the forest worm was making bad work with the maples in his vicinity, and requested information regarding the pest. In many parts of Greene county this insect was very destructive. In Lewis county C. C. Merriam of Lyon Falls writes that the forest worms are worse than he had ever seen them in his life. Many similar expressions could be taken from the letters of correspondents living in other parts of the state. During the latter part of May and in early June a large amount of the correspondence of the office related to this pest. Had it not been for most energetic efforts on the part of both local authorities and private parties, a large proportion of the thousands of sugar maples adorning the village of Saratoga Springs would have been defoliated. So serious was the situation that a special circular was issued and distributed through the village, in order to place in the hands of every person concise directions for controlling the pests. Shade trees in Albany, Schenectady and other cities and towns along the Mohawk river were attacked, and in a number of instances the trees were stripped of leaves. In certain towns 10 cents a

quart was offered for all cocoons collected. As a result, 1350 quarts were bought by the village authorities of Glens Falls, 744 by Saratoga Springs, 450 by Mohawk, and reports of similar action in several other places also came to me.

An examination of trees in infested localities has shown that many egg clusters can not be collected to good advantage as they are frequently found 20 to 50 feet from the ground. But as a large proportion of the eggs occur on twigs within 20 or 30 feet of the ground, something can be accomplished in winter by cutting off the infested twigs where accessible and burning the egg clusters, specially if the trees are not very large. But in the case of good sized maples, it is very doubtful if this could be done to advantage, and even with moderate sized trees there would probably be enough inaccessible egg belts near the top to stock the trees with a host the coming spring. At best, the collection of eggs of this species can hardly be regarded as more than one of several repressive measures, no one of which can be depended on in itself to prevent serious injury. The egg belts can be seen best on a bright day and if there is a little snow, it will be easier to find all cut twigs dropped to the ground. The collection and burning of the eggs is necessary in order to insure thorough work. A long handled pruning hook is of great service in cutting off the infested twigs.

As soon as the presence of the young caterpillars (indicated by the thinness of the foliage of the upper branches) is detected, much can be accomplished by crushing them as they collect on the limbs or by dislodging them with a brush or torch. If the latter is used, care must be exercised not to injure the tree. Many caterpillars can be jarred from the tree by using padded mallets or even violent shaking will cause some to drop. Driving the caterpillars from the trees by jarring or otherwise, must be followed by some means of preventing their ascent. A band of cotton batting eight to 10 inches wide tied tightly in the middle around the trunk and the upper portion turned down over the string and allowed to hang loosely is a difficult obstacle for caterpillars to surmount, so long as it remains dry. Wide bands of paper coated with tar or of sticky fly paper will also prevent the pests from ascending for a time. A band composed of equal parts of lard and sulfur is said to be an effective barrier. In one locality bands of cottolene were used to prevent the caterpillars from climbing trees. When the pests are abundant, it will not do to depend entirely upon shaking and bands, the dropping creatures must be collected on sheets spread under the trees before they are jarred and then killed, or crushed as they collect under the bands. Nothing but

most vigorous methods will protect badly infested trees from severe injury. The masses of caterpillars found on the larger limbs and on the trunk can be crushed in large numbers with a stiff broom or thickly gloved hands. A more agreeable method is to spray these clusters with kerosene emulsion or with whale oil soap solution (one pound to four gallons), or to pour boiling water over them.

This pest can be controlled by spraying with arsenical poisons where the trees are not too large for the apparatus at hand. If the caterpillars are nearly full grown and many are crawling to the sprayed trees from others, it is perfectly possible that all the foliage will be devoured before the pests have eaten enough poison to kill them, but under most conditions there need be little fear of the arsenical spray proving ineffectual if it is properly applied. The cost attendant upon this method will lead people to depend largely on other means.

After the damage has been done, many of the insects are within man's power and can be killed in their cocoons. From about the middle to the last of June thousands of cocoons can be collected with but little labor and if this is done opportunity should be given the beneficial parasites to escape before the cocoons are destroyed. Every healthy female pupa killed means one less egg mass to produce its approximately 150 or 200 hungry caterpillars another season.

It is believed that by fighting this insect in the egg, caterpillar and pupa states our shade trees can be preserved from serious injury. Native birds should be protected in all localities and, specially in forests, they must be our principal allies in subduing this terrible pest. Robins, orioles, chipping sparrows, cat birds, cuckoos, red eyed, white eyed and warbling vireos, cedar birds and nuthatches have been observed feeding on this insect by Caroline G. Soule. E. H. Forbush, ornithologist to the state board of agriculture of Massachusetts has kindly supplied me with the following list of birds observed feeding on forest tent caterpillars: oriole, black billed cuckoo, yellow billed cuckoo, crow, blue jay, redstart, nuthatch, woodthrush, chewink, black and white creeper, red eyed vireo, flicker and scarlet tanager. V. H. Lowe has observed the black capped chickadee feeding on the eggs. Prof. C. M. Weed states that the robin, chipping sparrow, yellow bird and English sparrow feed on the moths.

17 year cicada. Considerable interest was manifested in the appearance in the western part of the state of brood 19 of Cicada septendecim Linn. The following list of localities, incomplete though it be, is given as a matter of record. Cayuga county: the cicada

was reported very abundant at Union Springs by J. Jay Barden and as present at Auburn by Joseph Foord. Much damage was said to have been caused in the former locality, but later this report was modified as the injury proved to be less than was at first supposed. Livingston county: W. R. Houston reported the cicada to be in numbers at Geneseo, present at Groveland and very abundant at Avon. Monroe county: Lewis Hooker found it at Rochester and M. S. Baxter sent in specimens from Penfield. Onondaga county: Miss A. M. Armstrong found it in large numbers at Syracuse. Yates county: Cyrus Crosby reported the cicada present in greater or less numbers at Dresden, Bellona, Long Point and Mays Mill.

Drepanosiphum acerifolii Thos. The drouth, specially in the western part of the state, has apparently been very favorable to this beautiful species. At Onondaga Valley, Syracuse, in early September many maple leaves had fallen, those in the upper portions of the trees were badly curled and much honeydew was seen on the foliage. The trees proved to be badly infested with this plant louse, which was doubtless at least partly responsible for the bad condition of the trees. At Batavia many infested maples were seen but the injury was not so great as at Syracuse. The work of this species was also observed at Amsterdam and in Albany, but it was doing less damage in the latter place. A few Syrphid larvae were found on the infested trees.

Experiments with arsenical poisons. Comparative experiments with a few of the more important arsenical poisons were conducted last spring in connection with field observations. Vigorous elm leaf beetles, Galerucella luteola Müll., were collected May 4 and 10 placed in each of six breeding cages. All were provided with twigs of English elm bearing tender leaves. The ends of the twigs were placed in small bottles of water in order to keep the foliage fresh. All were treated alike, except that the leaves in cages no. 1–5 were thoroughly sprayed with poisons as given in the table below. An atomizer was used for spraying and whenever it was found necessary to renew the leaves, because of their wilted condition, the foliage was treated as at first and the spray allowed to dry before the fresh food was placed in the cage. This prevented any disturbance in feeding owing to the leaves being wet. In starting the experiment, the sprayed leaves were placed in the cages wet because that would be their condition after spraying outdoors, though in most cases the water would evaporate much more quickly than in the cages.

EXPERIMENTS WITH

DATE	PARIS GREEN, 1 LB. to 100 GAL. 35 GR. TO 2 QTS (1)	LONDON PURPLE, 1 LB. TO 100 GAL. 35 GR. TO 2 QTS (2)	PARAGRENE, 1 LB. TO 100 GAL. 35 GR. TO 2 QTS (3)
1899 My 4	Leaves sprayed about 4.45 p. m.	Leaves sprayed about 4.45 p. m.	Leaves sprayed about 4.45 p. m.
5	A number of holes have already been eaten in the leaves.	Beetles apparently have eaten nothing.	A few beetles on the leaves but no signs of feeding.
6	Beetles have fed quite a little, spray nearly dry.	Beetles have not fed so much as in no. 1, leaves wet with spray.	Beetles have fed little, spray nearly dry.
7	Beetles feeding freely, one on its back and just alive, spray has dried.	Beetles have apparently fed but little, 2 dead, spray has dried.	Beetles fed some, spray dry. Leaves eaten less than in either no. 1 or 2.
8	Beetles feeding rather freely, 1 dead.	3 dead, but little eaten apparently.	1 dead, leaves apparently eaten but little.
3.55 p m.	More foliage was eaten than in other cages with poisoned leaves. 1 nearly dead, but 8 found. Fresh leaves supplied.	Very little of the old foliage eaten, beetles possibly may have died from other causes than poison. Fresh leaves supplied.	Old leaves eaten but little. Fresh leaves supplied.
9	Considerable eaten, 2 dead, 1 nearly so.	Beetles feeding considerably.	Considerable eaten.
10 1.30 p.m.	4 dead, remainder feeding freely.	2 dead, others feeding freely.	3 dead, others still feeding.
11	1 dead, remaining one on leaf.	1 nearly dead.	2 dead, 3 nearly so.
12	1 dead.	3 dead.	4 dead.
13			
14			
15			
16			
17			
18			

ELM LEAF BEETLE

LEAD ARSENATE, 11 OZ. LEAD ACETATE, 4 OZ. SODA ARSENATE TO 40 GAL. 60 GR. LEAD ACETATE, 22 GR. SODA ARSENATE TO 2 QTS (4)	LEAD ARSENATE, 11 OZ. LEAD ACETATE, 4 OZ. SODA ARSENATE TO 80 GAL. 30 GR. LEAD ACETATE, 11 GR. SODA ARSENATE TO 2 QTS (5)	CHECK CAGE FREE FROM POISON (6)
Leaves sprayed about 4.45 p. m.	Leaves sprayed about 4.45 p.m.	Leaves sprayed about 4.45 p. m.
Leaves eaten about as much as in no. 5. Most of the beetles on the leaves.	A little more feeding has been done than in no. 1 and more beetles are on the leaves.	The beetles ate considerably more than any on poisoned leaves. As the sprayed foliage is still wet, this has probably discouraged feeding.
Beetles feeding considerably. 1 lot of eggs, spray dry.	Beetles feeding considerably (not quite as much as in no. 4), leaves still wet in places.	Beetles feeding readily Have eaten considerably more than in other lots.
Beetles feeding readily, 3 loose eggs on bottom of jar.	Beetles feeding considerably (little less than in no. 4), spray has dried.	Beetles feeding much more than those on poisoned foliage.
Leaves eaten considerably, rather dry. Old leaves removed and examination shows that they have been eaten but little. Fresh leaves supplied.	Leaves eaten considerably, food becoming dry. Fresh leaves supplied. An examination of the foliage shows that a relatively small proportion of the old was eaten.	Leaves much more eaten than those poisoned.
Considerable eaten.	Beetles have eaten more than in no. 1–4.	Beetles eating much more than in no. 1–5.
1 dead, others on foliage, which has wilted. Leaves eaten considerably, fresh supplied at 4 p. m.	Beetles have eaten considerable. Fresh food supplied at 4 p. m.	Beetles eating much more than in no. 1–4 and rather more than no. 5. But 9 beetles, fresh food supplied at 3.15, 3 egg clusters containing about 60 eggs found.
Leaves eaten considerably, beetles all on the foliage.	2 nearly dead, others feeding some.	Beetles feeding some on fresh foliage.
1 dead, others appear sick. Considerable eaten,	3 dead, 3 nearly so, others feeding.	Beetles feeding freely, 1 cluster of eggs.
2 dead, 2 nearly so. Leaves eaten considerably. Fresh food supplied at 5 p. m.	2 dead, 1 nearly so. Foliage apparently not eaten much. Fresh food supplied at 5 p. m., but 3 beetles.	
1 dead, 2 nearly so. Leaves eaten some at 3.30 p. m.	1 dead, 1 apparently sick, but little feeding at 3.30 p. m.	
2 dead.	1 nearly dead.	
1 dead.	1 dead.	1 dead. Food in bad condition, as they had received no fresh leaves since the 10th.
	Last one sickly.	
1 practically dead.	1 dead.	

The above record shows that arsenate of lead is slower in action than either of the other poisons and that in this experiment the smaller amount of the arsenate was fully as effective as the larger. Examinations showed that apparently more of the foliage was eaten in no. 5 than in no. 4, and if that be the case, the apparent anomaly may be explained, as the beetles in no. 5 probably got a fatal dose as soon as those in no. 4, in spite of the fact that in no. 4 the poison was double strength. Though the arsenate of lead operates more slowly, it was clearly shown by last summer's experience in the field that when the application was thorough and timely, shade trees suffered very little from attacks by the elm leaf beetle, and as this poison remains an indefinite time on the foliage it can hardly be surpassed as a substance for controlling such an insect as this elm pest, which feeds for a considerable part of the growing season.

The following record of an experiment with nearly full grown forest tent caterpillars shows that this species can be controlled with a poisonous spray even when the caterpillars are full grown. It also illustrates the effective, though somewhat slower action of arsenate of lead.

EXPERIMENTS WITH FOREST TENT CATERPILLAR

1899 June 6	Five caterpillars were put in a jar with maple leaves sprayed with 1 lb. paris green to 200 gal. water.	Five caterpillars were put in a jar with leaves sprayed with 4 oz. soda arsenate and 11 oz. lead acetate to 160 gal.
8	2 dead, 1 apparently dying, leaves comparatively fresh. Caterpillars have fed considerably.	1 nearly dead, caterpillars have fed only a little.
9	1 lively, 1 spun up, 1 nearly dead, leaves much wilted.	1 dead, leaves much wilted.
10	Freshly sprayed leaves were supplied.	1 spun up. Freshly sprayed leaves were supplied.
12	2 dead.	1 dead, 1 lively, 1 spun up.
	Moth never emerged.	Moths never emerged.

Some maple trees in Albany badly infested with forest tent caterpillars were sprayed on May 22 with W. H. Swift & Co.'s preparation of arsenate of lead and on the 27th dead caterpillars were abundant on the trees and around the base of the trunks, a striking illustration of the effectiveness of this poison. Further, I have elm leaves which were last sprayed May 22 and on October 25, after they had fallen, the poison was found in considerable quantity on them, showing the adhesiveness of the preparation.

VOLUNTARY ENTOMOLOGIC SERVICE OF NEW YORK STATE

The establishment of this service was the result of the conviction that the office should be brought into closer relations with the public it is designed to serve, and that, if properly managed, such an organization would result in bringing together much valuable information. It was the aim not only to obtain facts of immediate value, that is, those relating to the destructiveness of a pest, its occurrence in numbers, etc. but also to begin records which in the course of time would prove of great service in determining to some extent the causes governing the distribution of insects and their relative abundance, or effecting changes in habit.

A circular letter was prepared in the winter months and sent to parties in all sections of the state. It outlined the work as follows:

To all interested in entomology:

New York state with its enormous and varied agricultural interests suffers immense losses yearly from the depredations of insects. Its large area renders it impossible for one man, or even a moderate force of men, to observe properly the many insects within its borders, and warn the inhabitants of threatened loss by their attacks. In order to bring this office into closer relations with the public and render it of greater practical value, it is desired to establish an auxiliary force of voluntary observers who will serve without pay, and send short reports to the state entomologist weekly during the growing season and less frequently at other times. Though few entomologists will be able to take up this work, many valuable facts regarding the relative abundance of insects, the extent of their depredations, the effect of climate, soil and altitude, the distribution and spread of insect pests, etc., may be collected from all sections of the state. As necessity arises, directions will be issued in regard to what insects should be looked for and where the observations should be made.

Voluntary observers will be appointed by the regents on the recommendation of the state entomologist, and will receive copies of future state entomologic publications. Each person will be given due credit in these publications for all his observations and contributions of specimens, and in the course of a year should learn many valuable facts, as all inquiries for further information concerning an insect or in regard to its identity will be cheerfully answered. Those wishing to join in this volunteer service are respectfully requested to communicate at once with the undersigned, and, as an earnest of what may be expected in the future, to send in a few of their more important observations on insects of last year. All observations should be recorded, as they are always of value, and the absence of records is difficult to supply in later years. Soon after the appointments are made, appropriate stationery will be sent to those selected.

The plan offers present correspondents the advantage that it will systemize their work and increase the interest of all in the important study of applied or economic entomology. If the recipient of this communication does not care to undertake personal observations, he is requested to place it in the hands of one who will be interested in taking part in the service.

It was the intention to have approximately one observer in each county, though it was by no means expected that every county would be represented. From the list of applicants, the appointment of 39 persons representing 33 counties was recommended April 19. This number was augmented by the subsequent appointment of eight others and in turn was reduced by the resignation of four. One resigned on the receipt of the stationery, on account of its appearing too official. Another was forced to give up the work before its inception, because of a severe illness, and two others found themselves unable to comply with the requirements from pressure of other duties. On May 16 a circular letter with copies of bulletin 26 was mailed to 42 observers. The following extracts from the letter are given to show the general scope of the work:

To voluntary observers:

It is not expected that many will have time to prepare long reports. I desire specially to gather in brief form the observations and experiences of practical men with insects. Under no circumstances, omit the weekly report during the growing season, for even negative results have value. It is most desirable that the reports should be regular and received in Albany about the same time, so that they may be collated and the more valuable facts made known. For this reason each observer is urged to mail his report every Wednesday or Thursday in order that it may be received at the office on Friday of each week. 10 stamped envelops, with paper, are sent herewith and more will be supplied as needed.

The matter of more general interest in the reports will be brought together in brief form and supplied to agricultural papers, each observer receiving full credit for his work. For the most part, give attention to species of economic importance, such as those injuring plants of value, annoying live stock or proving a nuisance in the household. Inquiries regarding insects will be welcomed and answered as fully as practicable. In most cases the reports will be more valuable if accompanied by specimens of the insect or its work, preferably both. Useful hints for collecting and observing insects will be found in *Museum bulletin 26*, mailed under separate cover. The species mentioned under "Distribution of insects" are of special interest and should receive close observation from every fruit grower and farmer.

Finally, do not become discouraged if at first there appears little that is new or of interest, but record what is seen, because one object of this organization is to ascertain actual facts regarding insect life. In time the eye will become trained and many things, hitherto unnoticed, will be observed, and much of this will be of considerable value not only to the

scientist and the public, but to the observer. Though the appointments were unfortunately delayed longer than was desired, it is a decided advantage to begin such work when there is plenty to see.

In work of this nature it is difficult to make definite statements regarding the value of the service. There are now 43 observers on the list, representing 39 counties. If we summarize the work to Saturday, August 12, since which date there has been relatively little to report on account of the dry weather and the natural partial cessation of insect activities, a total of 200 reports have been received, a little over 15 for each of the 13 weeks, or an average for each observer, if we deduct the names of those who for some cause have failed to send in one report, of five each. On looking over the record it will be found that three observers have submitted but one report during the season; four, two reports; four, three reports; and six, four reports. Though these numbers are low for a period of 13 weeks, it must be remembered that this is a voluntary service on the part of the individual and in some instances was undertaken simply to help on what was regarded as a good work. During this period some have been ill, others have changed their plans and have found themselves away from home much more than was expected in the early spring. A few have sent in reports only when they saw something, and I have been assured from certain localities that no injurious insects had proved troublesome. While an entomologist, who had the training and the leisure to look for insects, would find much of interest, the case is by no means the same when a busy man undertakes the task with little or no previous training. Though a number have sent in relatively few reports, others have been most faithful and have proved themselves valuable agents. During this period, two observers sent in 11 reports; two, 10; and three, nine. As is well known to naturalists, the value of the report lies in its contents and not in its length. In this respect, most of the reports have averaged very well, while those of a few observers could hardly be improved. Abridged summaries of the reports received from the voluntary observers have been printed weekly in the *Country gentleman*, published at Albany, and almost weekly in the *New York farmer*, published at Port Jervis. Copies of the earlier summaries were sent to several other agricultural papers having a circulation in New York state, but, as they did not care to use the matter, no more were sent to them.

In summarizing, it will be interesting to see how the establishment of the organization has accomplished the desired ends. The correspondence of the office has been very much larger the present season than in any since my connection with it. Some of the increase was undoubtedly due

to other causes, but a considerable proportion, aside from correspondence with the observers themselves, I attribute to the activity of the voluntary observers in advising others where to apply for information. One man has been particularly active in this respect. It has been a source of gratification to note that almost every outbreak of injurious insects in the state has at some time or other been brought to my notice through the voluntary observers, even though my first knowledge of it may have come through other channels. I must add that in every instance the reports of these agents have been conservative and trustworthy, so far as I know. Toward the latter part of the summer the observers got hold of the idea much better than earlier, and the later reports have maintained a higher average. It is yet early to state much as to the value of the reports in settling questions regarding influences affecting insects. That can be determined only by observations extending through a series of years. But from what is at hand, it seems very probable that our expectations in that respect will not be disappointed.

For some reason or other, nothing was heard from three persons after they had been appointed voluntary observers. They are F. Johnson, Westfield, Chautauqua co., R. R. Livingston, Cheviot, Columbia co., and F. B. Lester, Westport, Essex co. Summaries of the reports received from the other observers are given below.

Summaries of reports

The names inserted in brackets indicate determinations by the entomologist. The others are presumably correct except where questioned. The dates given after the records are those of the reception of the reports, and are from one to three days later than the writing of the report.

Albany county (E. T. Schoonmaker, Cedarhill)—Cicada [C. tibicen] has appeared in limited numbers. Imported cabbage worms [Pieris rapae] numerous and destructive. July 17. Katydids have appeared this week, cicadas are more numerous. Aug. 8. Second brood of Colorado potato beetles [Doryphora 10-lineata] have appeared in limited numbers. Plant lice are doing considerable injury to elm leaves. Aug. 21. Harvest fly [Cicada tibicen] is still heard. Fall web worms [Hyphantria cunea] are plenty and doing some damage. Striped black walnut caterpillar [? Datana species] is causing some injury. Sep. 5.

Broome county (J. Mace Smith, Binghamton)—Apple tree tent caterpillar [Clisiocampa americana] is exceedingly abundant

and has done very much damage where the trees have been left to themselves. Forest tent caterpillar [Clisiocampa disstria] relatively scarce. In a few instances the leaves of currant bushes are nearly destroyed by plant ice [Myzus ribis]. June 3. Apple tree tent caterpillars have spun their cocoons. The birds have been very industriously destroying them, specially the wax wing, which more than all others seemed to have no other business on hand. Willow butterfly larvae, Euvanessa antiopa, have done some damage to elms and have stripped leaves from single limbs but in no case more. June 19. Potato beetles [Doryphora 10-lineata] are fewer in number than for years and are consequently doing less damage. Squash bug [Anasa tristis] and striped cucumber beetle [Diabrotica vittata] have been less injurious than usual. July 7. Since July 15 I have found many egg masses of the apple tree tent caterpillar and of the forest tent caterpillar that had been destroyed by insects, but have been unable to find the one doing it. The caterpillar of the cabbage butterfly [Pieris rapae] is as destructive as ever. Aug. 8.

Cayuga county (Joseph Foord & Sons, Auburn)—Cicadas [Cicada septendecim] are here in our vicinity. They were discovered June 5. [On this latter date J. Jay Barden reported the same insect in vast numbers at Union Springs] June 9. Larvae of [Schizura unicornis] are attacking plum trees in this vicinity. Aug. 29.

Columbia county (G. T. Powell, Ghent)—There has been an entire absence of pear psylla [P. pyricola] in my orchard, though I have been obliged to fight it for the past 10 years, losing 700 trees and 10 crops of fruit. Apple tree tent caterpillar [Clisiocampa americana] is not so numerous as usual; spraying with arsenic is very effectual. Apple aphis [Aphis mali] is serious on young trees but can be controlled by spraying with kerosene and water. The bud moth [Tmetocera ocellana] is the worst pest of the season. Pear midge [Diplosis pyrivora] is found in every Lawrence pear. We send men into these trees and cut off the pears and burn them. May 24. Apple aphis is persistent on young trees, cherry aphis [Myzus cerasi] is developing. Forest tent caterpillars [Clisiocampa disstria] have shown a wonderful increase in the past week. They are infesting the maples specially, but are numerous on elm, larch, apple, pear, oak and ash trees. June 6. Striped squash beetle [Diabrotica vittata] has made havoc with squashes, melons and cucumbers. An application of lime and

arsenic has served to keep them off the leaves but they go into the ground and attack the stalk. Squash bugs [Anasa tristis] are also abundant. Four lined leaf bug [Poecilocapsus lineatus] is doing much damage to currants, specially to young plants. June 15. Wire worms have been very destructive the past two weeks to cabbage and cauliflower. No evidence of second brood of pear psylla or of the currant worm [Pteronus ribesii]. White arsenic has been more effective in spraying than paris green. July 1. The pear psylla has begun to appear. The first brood was very light, scarcely an adult to be found, but the dry weather has been favorable to the hatching of every egg. The trees have been sprayed with 8% of kerosene, but as the insects are covered each with a globule of honeydew, the insecticide is very ineffective. If dry weather continues, the pear crop will be ruined. July 5. Timely and heavy showers have done much to check the pear psylla; spraying with kerosene emulsion, 1 to 15, is more effective immediately after a rain. Apple aphis is persistent. Lady bugs very abundant. Fall web worm [Hyphantria cunea] is now working. July 14. Fall web worm begins to show its work on fruit and forest trees. Apple aphis is very persistent, injuring many trees. July 28. A few late caterpillars [possibly Clisiocampa disstria, though more likely Datana ministra or Schizura concinna] are found on the apple trees. Apple aphis still persistent. Aug. 12. Borers [probably Saperda candida] unusually numerous and active in apple and quince trees. Large numbers of eggs have been deposited and as many as 30 young larvae have been taken from a tree. Aug. 17.

Delaware county (F. M. Simpson, Delhi)—Forest tent caterpillar [Clisiocampa disstria] in the sugar maples and causing much injury. They attack trees set out last year and completely defoliate them. Old trees suffer very much. The caterpillars begin in the upper branches and denude the limbs. Some trees have been protected by shaking the caterpillars from them and fair results have been obtained by spraying with paris green and water. May 25. Forest tent caterpillar still working havoc in this village and vicinity. June 2. I find that the groves of maples where the trees were partly defoliated by the forest tent caterpillar are completely destitute of leaves, while the foliage is still green on trees that were not attacked. Sep. 30.

Dutchess county (H. D. Lewis, Annandale)—Cold weather has somewhat checked insect activity, but even taking this into consideration,

there appears to be a short crop of injurious insects. Apple tree tent caterpillars [Clisiocampa americana] are not up to the average, and those seen appear to be less active. May 9. A few elm leaf beetles [Galerucella luteola] have made their appearance in the southern part of the township. Insect pests very scarce. May 27. Work of forest tent caterpillars [Clisiocampa disstria] not seen. Aphids are appearing somewhat, specially the black cherry aphis [Myzus cerasi]. Potato beetles [Doryphora 10-lineata] not abundant. June 2. A decided increase in plant lice of all kinds, in spite of the dry weather. One attack by forest tent caterpillars on about 10 or 12 trees has been brought to my attention. Potato beetles more numerous. Rose bugs [Macrodactylus subspinosus] very numerous. Currant worms [Pteronus ribesii] abundant. June 16. Apple aphis still increasing in numbers and doing considerable injury to recently set trees and in some cases to the new growth of mature trees. June 30. A few trees in this section badly affected by elm leaf beetle. The pest is not so bad as two or three years ago but worse than last year. Work of the codling moth [Carpocapsa pomonella] is beginning to show. I am satisfied that if orchards were persistently sprayed and all wormy fruit destroyed this pest would be much reduced. July 29.

(Ruth Sherwood, Fishkill)—Apple aphis [Aphis mali] present in numbers. Grape vine flea beetle [Haltica chalybea] is doing much injury by eating out the buds. May 20. The foliage of forest and fruit trees shows no injury from insects. Grape vine flea beetles inflicting much injury on young apples. Horse flies [Tabanidae] very annoying to cows. June 10.

(Franklin A. Taber, Poughkeepsie)—Cold, dry weather has been unfavorable for many insects. A few apple tree tent caterpillars [Clisiocampa americana] and currant worms [Pteronus ribesii] have appeared. Black flea beetles [Epitrix cucumeris] have appeared on early potatoes No Colorado potato beetles [Doryphora 10-lineata] in sight, not even an old one. A few aphids on sour cherries. Larvae of grape vine flea beetle [Haltica chalybea] attacking grape leaves, most numerous next to the woods on the north side of the vineyard. May 25. This season has been marked by fewer insect pests than for years. There was a late crop of potato beetles which did little damage. An insect has been working in the stems of potato vines. Aug. 11.

Erie county (M. F. Adams, Buffalo)—The syringa borer, Podosesia syringae, was found three years ago infesting and badly

injuring several hundred young ash trees. It was found that while the young larvae could be dug out, it was more practicable to kill the older ones by injecting carbon bisulfid in the burrows and sealing the holes with soap, or else using small pieces of potassium cyanid in place of the carbon bisulfid. This work can be done to best advantage in the fall or early spring. The carbon bisulfid injures the wood to some extent. May 24. Apple tree tent caterpillar [Clisiocampa americana] very abundant in the vicinity of Buffalo, but there are no signs of the presence of the forest tent caterpillar [Clisiocampa disstria]. Young larvae of the white-marked tussock moth [Notolophus leucostigma] were observed issuing from the egg May 29, and on the same date young of the apple tree bark louse [Mytilaspis pomorum] were crawling in great numbers on the limbs of apple trees. On this date a fully developed Agrilus anxius was removed from a birch tree and it was found that great numbers had pupated, though a few were still in the larval stage. On May 26 Saperda moesta was bred from Populus balsamifera; on May 30 Neoclytus erythrocephalus was reared from the dead branch of a beech tree. June 1. The work of Saperda tridentata, Magdalis armicollis and M. barbita on about 1500 elms is described, and the results obtained by cutting and burning the infested wood in the early spring were found to be very satisfactory. The beetles commenced to emerge May 16. June 10. Adults of Agrilus anxius began to issue from dry wood June 4. Many dead trees affected by this insect have been cut and burned and an effort is being made to preserve others by painting them with a mixture of resin and linseed oil (not boiled) in the proportion of about 5 pounds of resin to 1 quart of oil. In the summer of 1897 the birch trees were badly affected by an aphid [Callipterus betulaecolens Fitch] and many leaves dropped as a result. In 1898 the attack was renewed, but the pest was nearly destroyed by the larvae of the two spotted lady bug, Adalia bipunctata. The birch aphis has made its appearance the present season, but is being checked by the lady bug. The Canada fly or sand fly, as the creatures are known here, are stone flies, caddice flies and May flies. On June 1 the stone flies and caddice flies were noticed in great numbers; on the 14th the first May fly was seen. These insects breed on the Canada side of the Niagara river opposite Buffalo and are then carried across the stream by the prevailing winds. June 16. Larvae of the white-marked tussock moth [Notolophus leu-

costigma] are much less abundant than last year. In most cases where injury is being done, the cause is neglect to remove the egg masses. The larvae of Prionoxystus robiniae and those of Cyllene robiniae have destroyed nearly all the honey locust trees in the city, and on June 29 an adult of the former species was taken. June 30. Neoclytus erythrocephalus was observed July 4 ovipositing on a dying tree, Tilia americana. Phytoptus quadripes was so numerous on silver maple as to cause many leaves to wither and fall. The young larvae of Prionoxystus robiniae were found the same day in great numbers boring in the bark of oak trees, and adults of Saperda candida were taken on mountain ash (Pyrus sorbus) and on Paul's thorn (Crataegus oxyacantha var. paulii); this insect has nearly destroyed these trees in Buffalo. July 2 the larvae and pupae of Cryptorhynchus lapathi were taken from a Carolina poplar, and more recently the same stages were secured in Salix babylonica. The adults have been taken on Salix alba. White-marked tussock moth [Notolophus leucostigma] is now in the pupal state, no adults having been seen. July 13. Many Carolina poplars are being destroyed by Cryptorhynchus lapathi. Larvae of Agrilus anxius were found in the pupal cells July 14; young larvae about ¼ inch long were found July 19 feeding in the cambium layer, and had then traveled some distance. On investigating the cases of human injury attributed to the bite of the "kissing bug", it was learned that there were a number of sufferers and that examples of Opsicoetus personatus were readily found in the localities where most of the people were bitten. Adults of Saperda calcarata began to emerge from Populus monilifera July 18. This species is very destructive to the cottonwood and has been taken from other poplars. July 21. One prominent physician took four specimens of Opsicoetus personatus in his house. Every case which has come under my observation, since my last report, has been correct as regards the sting; the persons whom I have seen relate that they were bitten at night. White-marked tussock moth caterpillars [Notolophus leucostigma] have nearly all spun up and a number of egg masses have been deposited. From 85 to 90% of the whole brood has been destroyed by parasites, Pimpla inquisitor being the principal parasite; the next a Chalcis, which I believe to be C. ovata, with Pimpla conquisitor and a Tachina fly ranking after in importance. July 28. Agrilus anxius has been found thoroughly infesting black

birch, Betula lenta and the yellow birch, Betula lutea. From one spot 14 birches could be seen, two living, 12 dead. Examination of the dead trees showed the mines running in endless confusion, often crossing and recrossing, as in the white birch. I could not observe the discoloration, as in the white birch, which is possibly due to the bark of these trees being somewhat red in color. In Forest Lawn cemetery are about 50 dead and dying trees, as the result of the work of this insect. Aug. 9.

(J. U. Metz, East Amherst) — Up to date, I have seen but one Colorado potato beetle [Doryphora 10-lineata]. The asparagus beetle is on hand early. This beetle is new to me, as we were never bothered till this year. May 23. [Examples of both Crioceris asparagi and C. 12-punctata were received from Mr Metz May 31.] No injury by forest tent caterpillar observed. Apple tree tent caterpillars not numerous. June 17. Much damage is being done by the Hessian fly [Cecidomyia destructor]. Many fields are deteriorating daily. June 20. In my own fields, sown Sep. 9, I estimate that one fifth is down, in some fields sown in August one half to nine tenths are down as the result of the work of the Hessian fly. Even fields sown the latter part of September have some fly in them. July 3.

Fulton county (C. E. Childs, Mayfield)—Bumble bees more abundant on apple trees than for some years before. Apple tree tent caterpillars [Clisiocampa americana] seem to be infested with something which causes them to dry up and die before reaching maturity. No Colorado potato beetles [Doryphora 10-lineata] observed. May 22. Apple tree tent caterpillars have done some damage in this county and town. Forest tent caterpillars [Clisiocampa disstria] not doing much damage. In the village three large trees were nearly stripped of leaves. The trees were badly infested with borers [probably Plagionotus speciosus]. May 31. Colorado potato beetles not present in so great numbers as in previous years. Apple tree tent caterpillars have spun their cocoons. Forest tent caterpillars have been destructive in scattered localities. One lot in the mountains of about 30 acres was stripped of foliage. June 29. Locusts [probably Cicada tibicen] more numerous than in years. Grasshoppers more plenty than in seven years. Much damage has been done by forest tent caterpillar. Colorado potato beetles are giving much trouble now. July 25. Grasshoppers excessively abundant in some sections of the town. Aug. 7. Grasshoppers numerous in parts of the town and damaging crops somewhat. Aug. 9. Moths of the forest tent

caterpillar are flying in vast numbers; buckwheat in bloom is covered with them. Grasshoppers injuring crops some and rendering pastures and meadows bare. Aug. 22. In gathering up a bundle of corn, a man was stung on the arm by a larva [Automeris io, the io caterpillar]. The injured limb swelled, stiffened, was much inflamed and pained considerably for two days. Larva of [Philampelus pandorus] was taken on a raspberry bush. Aug. 28.

Genesee county (J. F. Rose, South Byron)—Last year was called a tent caterpillar [Clisiocampa americana] year, but it must have been a seeding for this. Where they have been controlled each year, they are easily taken care of this season. Many let them increase along the highway on seedling apples and wild cherries. Canker worm numerous in places where it has been in past years. Honest spraying controls them, but many farmers neglect this till the trees are brown and the worms large. Those who used wire traps either did not get them on in time or the females laid their eggs in the fall. A few pear psyllas [P. pyricola] found, but they have not seemed to develop. Common asparagus beetle [Crioceris asparagi] already noticed by one grower. Currant worms [Pteronus ribesii] appeared as usual, but were quickly killed by spraying with arsenite of lime and bordeaux mixture. May 20. Apple tree tent caterpillars never so bad before. For the past 10 days they have been crawling everywhere. Some of the largest orchards show hardly a green leaf as the result of canker worm attack. One grower used 1¾ pounds of green arsenite to 150 gallons of water in combination with bordeaux mixture and failed to kill the nearly grown canker worms. Pear psylla is very numerous this year and orchards are in bad condition, the small crop is dropping. There are two to 10 psyllas on the stem of each pear and the new growth is badly infested. I thought I could control it, but today am doubtful. I watched it closely and did thorough work before the mature insect appeared, used 10% kerosene oil (tried 15% on trees but the foliage was injured). As checks drenched some trees five times but mother insects are numerous today. Forest tent caterpillar [Clisiocampa disstria] is said to be stripping forests infested last year. June 6. Work of the forest tent caterpillar is not yet as serious as last year. Colorado potato beetles [Doryphora 10-lineata] are scarce. Squash bugs [Anasa tristis] and striped cucumber beetles [Diabrotica vittata] are as abundant as usual. June 22. Find a few nests of the fall web worm [Hyphantria cunea]. Farmers complain very little of potato beetles. Forest tent caterpillars have not caused one-

fourth the damage of former years. July 25. Potato beetles not abundant. Fall web worm still rare. Aug. 8. Codling moth [Carpocapsa pomonella] has worked in Bartlett pears the worst I ever knew it to do. Well sprayed trees will not average one third perfect fruit. Potato beetles giving no trouble. Aug. 22.

Greene county (O. Q. Flint, Athens)—Within the past week forest tent caterpillars [Clisiocampa disstria] have become quite noticeable in river towns like Athens, Catskill, Saugerties; something quite unusual. Apple tree tent caterpillars [Clisiocampa americana] are crawling about preparatory to spinning cocoons. June 3. Elm leaf beetle [Galerucella luteola] is doing considerable injury. Few tent caterpillars of either species are seen at present. June 8. Work of elm leaf beetle becoming very noticeable. Last year a number of elms in Athens were killed by this insect. June 23. Cocoons of the forest tent caterpillar are comparatively few at Hensonville, according to Mr Tremain Bloodgood, though the year before they were very abundant. Two or three miles distant, where the pests did not occur in numbers the previous year, cocoons are very abundant. Elms in Athens generally affected by the work of the elm leaf beetle. Fall web worm [Hyphantria cunea] attacking pear. July 1. The work of the forest tent caterpillar is very evident in the towns of Windham and Jewett. On examining the cocoons, there was no evidence of the moths having issued, on the contrary most of them had been parasitized. The people in that locality observed an absence of the moths, as compared with the preceding season. The elm leaf beetle does not appear to be present in the county back any distance from the river. The striped cucumber beetle [Diabrotica vittata] is said to be relatively scarce. July 22. In taking a drive to west of Middleburg, passing through portions of Greene, Albany and Schoharie counties, the work of the forest tent caterpillar was generally manifest in the mountains. A second brood of elm leaf beetles has appeared. Aug. 4. Striped cucumber beetle is said to have been scarce the last two years, specially so the present season. Aug. 26. Fall web worm present but not doing much injury. Grasshoppers fewer than usual. Sep. 2. Fall web worm has been working on pear trees to quite an extent. Pear psylla [P. pyricola] has been very injurious and difficult to control. Elms still badly affected by elm leaf beetle. Sep. 16. Pear psylla has been doing considerable harm in this section. [Pseudococcus aceris] is abundant on falling maple leaves. Sep. 20.

Herkimer county (G. S. Graves, Newport)—Forest tent caterpillars [Clisiocampa disstria] abundant on some small trees, 3 or 4 bushels have already been killed by hand. May 22. Trees are being defoliated about five miles from the village, in a locality where the caterpillars have been allowed to increase unmolested for the past two years. I have tried to watch the birds in caterpillar infested trees and have observed but two species which seemed to be feeding on them, the kingbird and the yellowbird. It seems as if some of the chippies or groundbirds ate them, but I have only indirect evidence. May 31. Forest tent caterpillar is not as noticeable as a week ago. Colorado potato beetles [Doryphora 10-lineata] are appearing, June 1 being the date they were first noticed. June 8. Forest tent caterpillars very plentiful in the woods. The injury to apple trees from both species of tent caterpillar, is in my opinion less than last year. Rose beetles [Macrodactylus subspinosus] injuring hydrangeas and rose bushes. Elms in the village affected to some extent by a beetle [Disonycha triangularis]. June 20. Rose beetle doing considerable damage to bushes. A large per cent of forest tent caterpillars spinning up in the leaves on the trees, apparently relatively few compared with the abundance of the caterpillars. There is also evidence of parasitic attack on this pest, as some of the cocoons have holes in the side. Lettuce badly affected by [Thrips tabaci]. June 27. Forest tent caterpillars have nearly disappeared. June 29. On June 26 the village board of Mohawk passed a resolution to pay 10c a quart for cocoons of the forest tent caterpillar collected in the village, and had by July 1 paid $45 for 450 quarts of cocoons. Moths of forest tent caterpillar very plentiful about electric lights during the fore part of the week. At 9.30 one evening I counted nearly 50 toads within a radius of 20 feet from one electric light, but was unable to see that they ate any of the moths of the forest tent caterpillar. July 10. Larvae of a beetle [Disonycha triangularis] are injuring elms to some extent. Find a few forest tent caterpillar cocoons on the small trees where I had attempted to kill all the larvae, but so far no egg belts. July 14. Potato beetles are not troublesome. Have seen little of the codling moth [Carpocapsa pomonella] on small apples. July 24. Egg belts of forest tent caterpillar appear relatively scarce when compared with the previous abundance of the larvae. Aug. 8. Parasites appear to have done much in this vicinity toward preventing the maturing of many forest tent caterpillar moths. Aug. 15. Butterflies of cabbage worm [Pieris rapae] abundant about fields. Aug. 24.

Jefferson county (George Staplin jr, Mannsville) — On April 25 apple tree tent caterpillars [Clisiocampa americana] began to hatch and now some trees are nearly stripped. Canker worms scarce. Texas or horn fly [Haematobia serrata] appeared May 12. Colorado potato beetles [Doryphora 10-lineata] not abundant. May beetles are very scarce and but few white grubs are to be found. May 24. Forest tent caterpillars [Clisiocampa disstria] are quite numerous on maples in Ellisburg, though they have not done much damage, but have been very injurious in Rutland, Watertown and some other sections. Curculios [? Conotrachelus nenuphar] are working on pears, also a few bud worms. Grasshoppers are reported very plenty in some localities. Texas fly and potato beetles about as usual. Canker worms not very plenty, spittle insects abundant. June 13. Yellow-necked apple tree worm [Datana ministra] and the fall web worm [Hyphantria cunea] appearing in young orchards. Rose leaf hopper [? Typhlocyba rosae] has been very destructive. Egg belts of apple tree tent caterpillar are numerous. July 26. Fall web worms appearing in small numbers, potato beetles not troublesome at present. Aug. 5.

Livingston county (W. R. Houston, Geneseo) — Apple tree tent caterpillars [Clisiocampa americana] have become a most serious pest in this section, 23 nests were counted on one tree. I find that spraying the trees with paris green, 8 ounces to 50 gallons of water, is a good remedy. Apple aphis [Aphis mali] is doing some injury to young trees. The asparagus beetle [Crioceris asparagi] has become a bad pest. May 17. 17 year cicada [C. septendecim] has appeared in this vicinity, and is present in large numbers. June 1. In this section, 17 year cicadas are all around in localities here and there; they are reported to be present at Groveland and Avon. Aphids on rose, apple, peach and currant have been worse than for 10 years. Cherry aphis [Myzus cerasi] is doing much damage. Forest tent caterpillars [Clisiocampa disstria] are doing little damage here in town, but are reported to be very abundant and destructive in Dansville. June 12. The rose worm [Monostegia rosae] has proved very destructive the present season. Whole plots of lettuce have been ruined by [Thrips tabaci]. June 17. Several cases of insect sting or bite have come to my attention in this vicinity, all being attributed to the work of the "kissing bug". July 17.

Madison county (C. A. Owen, Munnsville)—The lime tree winter moth [Erannis tiliaria] has nearly defoliated an orchard of

several acres in extent. Forest tent caterpillar [Clisiocampa disstria] nearly stripped the maples, but has now about disappeared. June 15. An occasional complaint is made of the work of tomato worms [Phlegethontius celeus]. Aug. 11.

Monroe county (Lewis Hooker, Rochester) — Pear psylla, P. pyricola, is quite thick in some of the Duchess pear orchards, and in some cases this insect is doing considerable harm. Canker worms, which in previous years were troublesome, have gradually disappeared, though in some localities they have been reported in large numbers. Apple tree tent caterpillars [Clisiocampa americana] generally present and in some orchards completely covering the trees. Forest tent caterpillars [Clisiocampa disstria] present in some sections, specially on chestnut trees. Bud moth [Tmetocera ocellana] and case bearers appear to be as numerous as in previous years and in some instances are hurting the trees. No signs of the codling moth [Carpocapsa pomonella] yet. May 24. Potato beetles not very plentiful. Apple tree tent caterpillars are very numerous in some sections of the county Adult pear psyllas may be found in small numbers. Plum curculio [Conotrachelus nenuphar] appears to be present in relatively small numbers. June 2. Canker worms have done considerable injury in this vicinity the past week, and in neglected orchards trees have been completely stripped. Black flea beetle [Epitrix cucumeris] present in large numbers on potatoes. Cut leaved birches of East avenue suffering from the attacks of a borer [possibly Agrilus anxius]. Green fruit worms [Xylina species] present in pear and apple orchards in large numbers and are doing great damage. Asparagus beetle [Crioceris asparagi] is troubling growers greatly. A colony of 17 year cicadas [Cicada septendecim] occurs on our place. June 6. Larvae of grape vine flea beetle [Haltica chalybea] present on grape leaves but doing little damage. No quince curculios [Conotrachelus crataegi] have been seen this year. New York plum scale [Lecanium prunastri] are very numerous in the egg state on German prune and Bradshaw plum orchards. June 14. Some Kieffer pear trees are badly infested with the scurfy bark louse, Chionaspis furfurus. Colorado potato beetle [Doryphora 10-lineata] has not appeared. Rose beetles [Macrodactylus subspinosus] are proving destructive to roses. Raspberry cane girdler [Oberea bimaculata] is working in blackberry beds. June 22. Aphis [Myzus ribis] on currant is very abundant. The currant worm

has appeared in considerable numbers on gooseberries. Plum scales [Lecanium prunastri] have hatched and are now on the under side of the leaves of the infested trees. June 30. Second brood of pear psylla is not numerous. Plum scale has done little injury. July 20. A large number of maples in Rochester are suffering from the attacks of the sugar maple borer [Plagionotus speciosus]. The infested trees have very scanty foliage this year and are gradually dying. Oct. 1.

Oneida county (Jeanette C. Miller, Aldercreek)—Colorado potato beetles [Doryphora 10-lineata] very numerous. Apple tree tent caterpillars [Clisiocampa americana] have been very abundant. The cherry Tortrix [Cacoecia cerasivorana] has spun its nests in almost every roadside bush and is very abundant. June 20. Young grasshoppers are very numerous. There is a second crop of both potato beetles and currant worms [Pteronus ribesii]. July 6. The two last named insects are diminishing in numbers. In Otsego county I saw a large sugar bush of many acres in extent entirely stripped by forest tent caterpillar [Clisiocampa disstria] of upper leaves; only a few lower branches had any foliage remaining. I heard that there were many similar acres. July 26. Fall web worm [Hyphantria cunea] numerous on cherry and maple trees. Aug. 8. Grasshoppers and other insects pleasingly scarce. Aug. 15. [Lithocolletis aceriella] working in maple leaves to some extent. Sep. 11.

Onondaga county (Miss A. M. Armstrong, Belle Isle)—Where not destroyed, apple tree tent caterpillars [Clisiocampa americana] have eaten every green leaf and bud. Small measuring worms, probably canker worms, are proving very destructive to apple trees. May 18. The work of canker worms is more general than was supposed last week. May 27. Apple trees attacked by canker worms completely stripped of foliage. June 2. Potato beetles becoming very numerous. Striped cucumber beetle [Diabrotica vittata] destroying squash, pumpkin, melon and cucumber vines. June 9. Canker worms have now buried themselves to a depth of about 2 inches in the soil about the trees. At Oakwood cemetery the 17 year cicada [C. septendecim] is present in large numbers, but is doing little damage. Many sparrows were busy feeding on the cicadas. At Onondaga Valley, Syracuse, much the same condition prevailed. Larvae of grape vine flea beetle [Haltica chalybea] abundant on grape vines, and considerable damage by them is reported from Baldwinsville. The wheat midge [Diplosis

tritici] and the Hessian fly [Cecidomyia destructor] are working in the wheat. June 16. The cicadas about Syracuse have done some damage, causing the tips of twigs to wilt and die. 10% of the wheat stalks are infested with Hessian fly, and 4% with the wheat midge. Grape vine flea beetle larvae have disappeared. June 23. Potato beetle still numerous. Wheat midge and Hessian fly are at work yet. Apple tree tent caterpillar moths have nearly all emerged. Hundreds of small, whitish butterflies [Pieris rapae] are flying about. Green-headed horseflies and the large black fly [Tabanus atratus] are abundant. House flies are not so numerous as usual. July 1. Wheat midge and Hessian fly are still found in wheat fields. Horseflies have appeared in large numbers and are very annoying to stock. July 7. Colorado potato beetle [Doryphora 10-lineata] is abundant and destructive. Golden tortoise beetles are present on morning-glory vines. White-marked tussock caterpillars [Notolophus leucostigma] are on horse-chestnut trees, but not abundant. July 15. Cabbage worms appearing, but not abundant. White-marked tussock caterpillars have spun their cocoons. July 22. Dog day cicadas [Cicada tibicen] are more numerous than usual. Egg belts of apple tree tent caterpillar are quite abundant. Codling moth is possibly a little more abundant than in former years. Spined soldier bugs are destroying many potato beetles. Fall web worms [Hyphantria cunea] are more numerous than usual. Aug. 12. Milkweed butterfly [Anosia plexippus] was quite numerous for a few days, more so than usual. The harvest fly [Cicada tibicen] was more abundant than I have known it to be before. Grape vine leaf hopper [Typhlocyba ?vitis] very plentiful. Oct. 2.

Ontario county (J. Jay Barden, Stanley)—Apple tree tent caterpillars [Clisiocampa americana] appeared April 13 on crab-apple buds, and bud moths [Tmetocera ocellana] were found at work on April 22 and cigar case bearers [Coleophora fletcherella] had begun to move. The bud moth has been very bad in unsprayed orchards, but seems to have been controlled by spraying before the buds opened. Forest tent caterpillars [Clisiocampa disstria] are more numerous than ever before, their work being plainly apparent in the tops of sugar maples. An orchard of about 50 trees looks as if swept by fire, the result of canker worm attack. May 31. Very little has been seen of the potato beetle. Many complain of the work of the four lined leaf bug [Poecilocapsus lineatus]. Larvae of the eight spotted forester [Alypia octomaculata]

have been defoliating grape vines. At Union Springs, Cayuga county, the 17 year cicada [C. septendecim] is present in enormous numbers and is apparently doing much damage. Currant stem girdler [Janus integer] is very bad about Stanley. June 20. Eggs of cicada unhatched. Young of San José scale [Aspidiotus perniciosus] appeared for the first time June 17 in small numbers, the morning of June 18 there were many more and on June 19 the tree was swarming with them. I was unable to find the young of Mytilaspis pomorum moving about, though they were numerous under the old scales. Currant stem girdler has become very prevalent in Ontario, Yates and Cayuga counties and is doing much damage. July 20.

Orange county (J. M. Dolph, Port Jervis) — Cherry tree aphis [Myzus cerasi] more abundant than usual. Currant bushes are badly affected by plant lice [Myzus ribis]. The greater abundance of insect eating birds the past two or three years apparently accounts for the lack of injurious insects. May 20. A black caterpillar [Euvanessa antiopa] appeared on Carolina poplars in considerable numbers. Have seen no forest tent caterpillars [Clisiocampa disstria]. May 27. Recent rains have reduced the numbers of plant lice. Cucumber flea beetle [Epitrix cucumeris] is destructive to cucumbers and tomatoes. June 2. Apple tree tent caterpillars [Clisiocampa americana] have been almost entirely absent. Cabbage butterfly [Pieris rapae] has been somewhat more plentiful than usual. Striped squash beetle, Diabrotica vittata, has done considerable damage in gardens, while the cucumber flea beetle has been perhaps the worst pest for gardeners. July 24.

Orleans county (Virgil Bogue, Albion)—Canker worms are not as destructive as last year, owing largely to their being controlled by spraying. Green fruit worms are more injurious than last year. White grubs and wire worms have worked but little. May beetles were more abundant than usual. Overwintered honey bees are doing splendidly, though not many have swarmed. Crimson clover has apparently increased the number of bumble bees. June 6. The season in this vicinity is the most nearly free from insect depredations of any that I have observed. Aug 22. Woolly apple aphis [Schizoneura lanigera] is quite prevalent in some orchards. Sep. 18.

Oswego county (C. B. Cook, Oswego Center)—The bud moth [Tmetocera ocellana], cigar case bearer [Coleophora fletcherella] and apple tree tent caterpillar [Clisiocampa

americana] are quite numerous. The pear psylla [P. pyricola] is doing much damage. Colorado potato beetles [Doryphora 10-lineata] are awaiting the appearance of the plants. May 31. Green aphis has been quite bad on fruit trees, specially apple. Cucumber flea beetle [Epitrix cucumeris] has been very destructive to tomatoes and is doing some injury to potatoes. June 7. Attacks of currant saw fly [Pteronus ribesii] have been comparatively light. Green fruit worms [Xylina species] cause considerable complaint. Plum curculio [Conotrachelus nenuphar] is unusually bad. Forest tent caterpillar [Clisiocampa disstria] has been inflicting some injury on both fruit and forest trees. June 14. Green aphis is very bad in places Striped cucumber beetles [Diabrotica vittata] have made their appearance the past week for the first time this season. June 21. Potato beetle inflicting little injury. June 27. White grubs are doing considerable harm in newly set strawberry beds. Stalk borer [Hydroecia nitela] occurs in small numbers in potato vines. Both codling moth [Carpocapsa pomonella] and plum curculio are unusually abundant. July 22. Fall web worms [Hyphantria cunea] are very scarce, cabbage worms are rather bad. Tomato worms [Phlegethontius celeus] are found occasionally, but are not causing much damage. Aug. 9. Considerable damage has been done by the second brood of the codling moth. Found a few asparagus beetle [Crioceris asparagi] larvae. White grubs are still destructive to young strawberry plants. Potato beetle remaining in numbers unusually late. Peach tree borer [Sanninoidea exitiosa] doing considerable damage. Sep. 20.

Queens county (C. L. Allen, Floral Park)—Colorado potato beetles [Doryphora 10-lineata] are just beginning to appear, all of two weeks later than usual; the vines were fully eight inches high before the first beetle was noticed. Cabbage butterfly, Pieris rapae, is now plentiful. The cabbage looper, Plusia brassicae, has not appeared. The asparagus beetle [Crioceris asparagi] is a most serious pest and never before was so plentiful. May 31. Apple tree aphis [A. mali] is very bad in young orchards. June 5. Potatoes badly infested with the cucumber flea beetle [Epitrix cucumeris] and unless we have rain at once the crop will be ruined. June 8. Potato beetle is now very troublesome. June 22. An aphis [Nectarophora destructor Johns.] has destroyed the pea crop in this section. One market gardener lost 20 acres, another 14, not a pea was picked from either. Potato beetle was never before so

destructive. July 5. Potato beetle still very injurious. Aug. 8. The striped cut worm [Carneades tessellata] has been very injurious. It eats almost any green thing, specially cabbage and cauliflower plants. I have seen in one field hundreds of plants cut completely off, or so nearly so that the tops dropped to the ground. From around one plant 20 of these destructive pests were dug out. Sep. 18.

Rensselaer county (W. C. Hitchcock, Cropseyville) — Grasshoppers [Schistocerca rubiginosa and probably others] are very abundant. May 24. Forest tent caterpillar [Clisiocampa disstria] is numerous in several localities. Elm leaf beetle [Galerucella luteola] is abundant; the Baltimore oriole is feeding on it. June 18.

Rockland county (S. B. Huested, Blauvelt) — Apple tree tent caterpillars [Clisiocampa americana] are comparatively rare. Pear midge [Diplosis pyrivora] is one of our worst enemies and has done its work. We notice an absence of birds, robins, etc. being fewer than usual. May 20. Work of the elm leaf beetle [Galerucella luteola] is less serious than usual. No Colorado potato beetles [Doryphora 10-lineata] seen. June 3. Cherry and apple aphids are plenty. Potato beetles appearing. Potato flea beetle [Epitrix cucumeris] does much damage. June 16. Rose beetles [Macrodactylus subspinosus] are present but not in large numbers. They appear to manifest a decided preference for the blossoms of tulip trees and it has been recommended to plant them in an orchard as a preventive of injury by this insect. June 24. Fall web worm [Hyphantria cunea] has appeared, but no great damage is done by it. Aug. 12.

St Lawrence county (Mary B. Sherman, Ogdensburg)—Forest tent caterpillars [Clisiocampa disstria] were first noticed about eight weeks ago on the small smooth branches of the younger apple trees. They are now about the size of a small pencil and about 1½ inches long, though there are still many young ones. Everything is infested, but as maples are abundant. the trees have not yet suffered severely. The forerunner of our shad fly [May fly] has appeared within the past two days. This we call the fish fly. The worst shad fly day is usually about June 5. Currant aphis [Myzus ribis] present in numbers. Currant worms [Pteronus ribesii] are as numerous as usual. June 3. A new currant worm [Diastictis ribearia the currant span worm] has appeared within 10 days in many gardens in

town. It is unaffected by hellebore. Forest tent caterpillars are not quite so numerous. Many of the apple trees are almost leafless in the country, [the work of Clisiocampa americana] while trees in the city are covered with caterpillars, though the foliage has not suffered very severely. Many small caterpillars are to be seen on the maple trees. The shad flies have appeared, but a south wind has taken most of them to the Canadian shore. June 8. Apple tree tent caterpillar [Clisiocampa americana] has been a very serious pest in the country. June 15. [Schizoneura americana] is abundant on elms, forming white, cottony masses. June 22. White grubs are unusually destructive to strawberry plants. Currant worms more troublesome than common. July 6. The raspberry cane girdler [Oberea bimaculata] has commenced its work, but is not nearly so troublesome as last year, when about half our bushes were killed. Picking and burning infested shoots has proved effective in controlling this pest. Egg belts of the forest tent caterpillar are beginning to be found; the moths are still numerous. July 14. Eggs of forest tent caterpillar are very numerous; on one small twig 9 inches long three egg belts were found. July 28. Cabbage butterflies [Pieris rapae] are abundant and causing great complaint. The two spotted tree hopper [Enchenopa binotata] is proving very destructive to the bittersweet. The tomato worm [Phlegethontius celeus] is more abundant than usual. Aug. 16. The large number of orange or dark brown and black butterflies [milkweed butterfly, Anosia plexippus] is appalling. They cling in masses as large as a two quart pail to maples and there are thousands flying about. They are very abundant in gardens. There are many complaints of the poultry mite which appears to be more troublesome than usual. A number of cut leaved birches have died [possibly the work of Agrilus anxius]. Sep. 1.

Saratoga county (Rhoda Thompson, Ballston Spa) — Apple tree and forest tent caterpillars have been fought with fire with tolerable success. Rose leaf hopper [Typhlocyba rosae] has been very abundant and injurious. May 25. Currant worm [Pteronus ribesii] is at work as usual. Larvae of grape vine plume moth [Oxyptilus periscelidactylus] are webbing up the tender tips. White grubs are destructive to all sorts of tender plants, tomatoes, cauliflowers, carnations, etc. Where fought early and persistently, the forest tent caterpillar [Clisiocampa disstria] has not inflicted much damage. June 2. Striped cucumber beetle [Diabrotica vittata] is devouring melon and squash vines, asters and dahlias.

Rose beetle [Macrodactylus subspinosus] is very common on roses, grape vines and spiraeas, and is causing some damage. Larvae of willow butterfly [Euvanessa antiopa] are attacking elms. Forest tent caterpillars [Clisiocampa disstria] are still to be found. June 16. Rose beetles are devouring everything, compelling hand picking to save roses and other cherished plants. June 24. Light-loving grape vine beetle [Anomala lucicola] is abundant. Caterpillars of the black swallow-tail [Papilio polyxenes] are feeding on carrots and caraway. July 7. The two beetles [Lucanus dama and Pelidnota punctata] were found in the decaying stump of a maple tree. July 28.

Schenectady county (John Bigsbee, Scotia)—Bud worm [Tmetocera ocellana] very abundant in one large apple orchard. June 6.

Seneca county (J. F. Hunt, Kendaia)—Apple tree tent caterpillar [Clisiocampa americana] has almost defoliated some young orchards and materially injured the crop on older trees. Grape vine flea beetle [Haltica chalybea] is relatively scarce the present season. Raspberry saw fly larvae [Monophadnoides rubi] have not appeared this season, though they did much damage in the past. Colorado potato beetles [Doryphora 10-lineata] are just making their appearance, much later and less abundant than usual. Plum curculios [Conotrachelus nenuphar] have begun their work on apricots, but do not seem as abundant as usual. May 25. Forest tent caterpillar [Clisiocampa disstria] has been very injurious to fruit trees, mostly to the cherry. Plum curculios have appeared in abundance; 55 were secured from an apricot tree and 140 from a plum tree, almost all found on one side of the orchard near a ravine where there are a number of elm trees. Some of the large plum orchards in the southern end of the county are infested to an unusual extent with the plum curculio. Raspberry saw fly is beginning to work, but is not as bad as in former years. Potato beetles are beginning to be numerous. June 2. Hessian fly [Cecidomyia destructor] is doing much damage to early-sown wheat all through the county. Rose slugs numerous. June 10. Hessian fly is doing much damage in some pieces of wheat, while others are comparatively free. June 30. It is estimated that 25% of the wheat crop has been injured by the Hessian fly. Potato beetles not as plentiful as some years. July 20. It is found that there is little shrunken wheat and that the work of the Hessian fly was not as bad as reported. Some of the injury was caused by dry weather. Aug. 9.

Steuben county (Levi Gardner, Atlanta)—Apple tree tent caterpillar [Clisiocampa americana] is about one fourth as abundant as usual. There are not enough forest tent caterpillars [Clisiocampa disstria] to cause any harm. There are a few currant worms [Pteronus ribesii]. Colorado potato beetles [Doryphora 10-lineata] have appeared. June 1. Plum curculio [Conotrachelus nenuphar] has been more destructive than usual. Potato beetles are comparatively harmless, cucumber flea beetles [Epitrix cucumeris] injuring potatoes much worse than usual. June 30. Codling moth [Carpocapsa pomonella] is possibly a little more abundant than in preceding years. July 27.

Suffolk county (W. B. Dupree, Centerport)—The only insect injuring crops in this section is the potato beetle, and it is easily kept in control with paris green. July 6. Foliage of hop vines badly damaged by the caterpillars of [Polygonia interrogationis]. Rose beetles [Macrodactylus subspinosus] in small numbers are skeletonizing the leaves of chestnuts. Aug. 14. Fall web worm [Hyphantria cunea] is causing noticeable injury to trees, as apple, oak and chestnut. Spotted grape vine beetle [Pelidnota punctata] scarce on wild grape. Io caterpillar [Automeris io] is found in small numbers on locust trees. Multitudes of black blister beetles [Epicauta pennsylvanica] cover golden rod. Aug. 31.

Tompkins county (C. E. Chapman, Peruville)—Apple tree tent caterpillars [Clisiocampa americana] are not numerous and do not seem to strip trees as usual. No potato beetles to be seen, though early potatoes are up. May 23. Forest tent caterpillar [Clisiocampa disstria] is denuding many of our forests and in places they are on fruit trees. Potato beetles now active and plenty. Cucumber flea beetle [Epitrix cucumeris] attacking potatoes and red raspberries. June 13. Corn at Ithaca was attacked to some extent by a worm, probably a species of Crambus. June 14.

Ulster county (G. S. Clarke, Milton) — Currant worms [Pteronus ribesii] are plenty. A few aphids may be found on apple, cherry, peach and currant foliage. May 27. Cherry aphis [Myzus cerasi] is doing some damage. Apple tree tent caterpillar [Clisiocampa americana] is not abundant, and there are no signs of injury to maple trees by the forest tent caterpillar [Clisiocampa disstria]. Currant aphis [Myzus ribis] is unusually abundant. June 2.

Aphids have increased some on cherry and currants and the apple aphis [Aphis mali] is doing some damage. No potato beetles have been seen. The second brood of currant worms has not appeared. June 10. A few fall web worms [Hyphantria cunea] have appeared. July 1. Apple aphis is persistent on young trees, where it is doing some damage. July 10 Apple aphis still on some trees. July 22. Apple aphis has nearly all disappeared. Aug. 5.

Warren county (C. L Williams, Glens Falls) — Forest tent caterpillars [Clisiocampa disstria] have done much damage in this place. They are now eating voraciously on hard maple, white elm, basswood and apple trees. At this date there are many caterpillars not half grown. A few caterpillars have apparently got their growth, but none have begun to spin up, so far as observed. June 3. Forest tent caterpillars are beginning to spin their cocoons; it was first observed on June 3. Many shade trees, hard maples, elms and basswood have been entirely defoliated. Damage has also been done in the villages of South Glens Falls, Saratoga county, and Sandyhill and Fort Edward, Washington county. June 9. Forest tent caterpillars are about through eating and are spinning up very rapidly. Multitudes of cocoons are spun among the leaves on which the caterpillars feed. Caterpillars of the willow butterfly [Euvanessa antiopa] are quite widely distributed over the village and in South Glens Falls. June 14. Moths of the forest tent caterpillars are beginning to appear. The board of trustees of Glens Falls advertized on June 17 to pay a bounty of 10c a quart for the cocoons Up to date there have been collected and destroyed 585 quarts of cocoons. The cocoons of the forest tent caterpillar are parasitized by several ichneumon flies. A Podisus spinosus was found among the cocoons of this insect. June 22. On June 26, the last cocoon was received, making a total of 1350 quarts destroyed at a cost of $135. June 30. Young corn is being attacked by the stalk borer [Hydroecia nitela]. July 12. Some little damage is being done to corn by the stalk borer; one farmer reports one stalk in five infested on new land, but no injury on old land. I have also found it working on old land. July 21. The stalk borer seems to be working in isolated places here and there. Aug. 3.

Washington county (H. L. Beadle. West Cambridge)—Canker worms have been comparatively scarce till this spring, a few may be found on nearly every tree that has not been sprayed. Apple tree tent caterpillars [Clisiocampa americana] are not very plenty. May

9. Trees about six miles north are nearly defoliated by forest tent caterpillars [Clisiocampa disstria] though there are scarcely any in the immediate vicinity. Horn fly [Haematobia serrata] is present in large numbers. Many orchards are literally covered with the scurfy bark louse [Chionaspis furfurus]. June 3. Colorado potato beetles are abundant and doing much damage. Grasshoppers are very numerous. July 7. Grasshoppers are doing much damage to oats. July 31. White grubs are plentiful in old meadows and hoed crops. Aug. 12.

Wayne county (C. H. Stuart, Newark)—Both species of asparagus beetles [Crioceris asparagi, C. 12-punctata] occur here. The work of the wheat midge [? Diplosis tritici] was extremely bad last year. Apple tree tent caterpillars [Clisiocampa americana] are doing great damage; we have found it necessary to send men with ladders to kill them by hand. May 20. Apple tree tent caterpillars are now full grown and seeking places to spin up. June 2. Larvae of apple tree tent caterpillars have disappeared, but forest tent caterpillars [Clisiocampa disstria] are nearly as abundant on walks as the other species have been. June 7. Larvae of raspberry saw fly [Monophadnoides rubi] are doing much damage, the leaves of the infested patch looked today like those of a badly infested currant bush. There is hardly a leaf in the field without several holes in it, and most of the older ones are eaten to threads. June 12. Work of the fly [Cecidomyia destructor] is very bad in wheat, a great amount of it being down. July 11. There is no evidence of work by the wheat midge, the clover midge [Cecidomyia leguminicola] and the onion thrips [Thrips tabaci]. The 12 spotted asparagus beetle seems to have disappeared. Nearly one third of the wheat is down and the damage may be perhaps one fourth of the entire yield, the result of Hessian fly work. It was specially bad on early-sown fields. July 25. A small green larva [subsequently identified by Mr Chittenden as the red banded leaf roller Lophoderus triferana] was found eating the green pop corn; it has attacked about 27% of the ears and 37% of the corn on the ear is destroyed. Sep. 19

Yates county (C. R. Crosby, Crosby)—Grape vine flea beetles [Haltica chalybea], though nearly as abundant as last season, have not done the damage they did last year, as growers knew what to expect and caught them as soon as they appeared. The warm weather lessened their destructiveness by bringing the foliage out faster. No

growers in this section used the paris green spray, as they seem to have little faith in its effectiveness. The beetles made their appearance about April 23 or 24. Both the apple tree and the forest tent caterpillars [Clisiocampa americana, C. disstria] are much more common than last year. In a peach orchard of 500 trees I counted more than two nests to each tree. The caterpillars of the gartered plume moth [Oxyptilus periscelidactylus] are webbing together the leaves of the terminal shoots. Leaves of some varieties of currants are badly curled by plant lice [Myzus ribis]. Currant worm [Pteronus ribesii] is very abundant on gooseberry. [Pyrausta futilalis Led.] was very abundant last year on dogbane [Apocynum androsaemifolium] and almost destroyed the weed. May 24. Click beetles numerous in quince blossoms. Many trees in a grove of maples are partly girdled by borers [Plagionotus speciosus], though they appear perfectly healthy in other respects. Lygus pratensis is very numerous on grape vines. Larvae of the grape vine flea beetle are beginning to appear. One house was overrun with the grain weevil [Calandra granaria]. Nymphs of [Leptoterna dolobrata] are abundant in grass. June 2. Crambids have become common. June beetles are a great nuisance at all kinds of evening meetings. On June 7 an adult of the round headed borer [Saperda candida] came to light. There is great complaint about squash beetles. June 9. Larch saw fly larvae [Lygaeonematus erichsonii] are doing considerable damage to larch trees. The same insect was injurious about four years ago. Caterpillars of the willow butterfly [Euvanessa antiopa] have nearly stripped some elms in the neighborhood. The 17 year cicada [Cicada septendecim] is reported to be present in great numbers near Dresden. June 16. The 12 spotted asparagus beetle [Crioceris 12-punctata] is by far the most numerous on wild plants. June 17 a visit to the farm of Calvin Haston near Dresden showed that the 17 year cicadas were apparently doing considerable damage in vineyards and young apple orchards, and more than half the branches of the vines were dead. On one small apple tree I counted eight females ovipositing at one time on three feet of branch. On one leaf of witch hazel 18 and on another 20 pupal skins were found. The adults were thickest in the orchard, where I gathered a pint without moving. The first chambers found were under a rail fence, while one was found in grass in the orchard. They were most abundant in the woods under dead leaves; many were built through the leaves and were four or five inches long. Some were capped and

others open. Only one lot was found in the woods uncovered by leaves, this occuring in a spot where a brush heap had been burned the preceding year, and here 30 or 40 chambers were found. The insects have also appeared at Balona, Mays Mill and Long point. At the last place they are reported as destroying two large vineyards. Caterpillars of the black swallowtail [Papilio polyxenes] are eating down young celery. June 23.

EXHIBITION OF INSECTS AT AGRICULTURAL GATHERINGS

The opportunities agriculturists have of visiting museums to study insect pests are necessarily limited, and not every farmer finds time to look through the many bulletins and other publications so freely distributed, or, if one has a few hours, the desirable article can not always be found. After all, the true way to learn is to see the creatures themselves, preferably living but much better dead than not at all, and to inspect their work. The observations of most growers are usually confined to the field and are limited to the destructive stage, the round of life being but partly understood. It is believed that a properly arranged biologic collection, representing the various stages of the principal insect pests, their work and any peculiarities they possess, will do much to increase the interest in insects, and should promote their more general study in the field, thus leading to their better control. As museums are few and widely scattered, one way to bring about this very desirable end is found in carrying small exhibits to places where the classes to be benefited assemble, viz: agricultural fairs, farmers' institutes, grange meetings and similar gatherings.

The interest manifested in the initial exhibit prepared for the state fair, held at Syracuse, Sep. 4–9 and subsequently shown at the Oswego county fair, held at Oswego Falls, Sep. 12–15 demonstrates the value of this work. The collection, contained in 12 glass covered cases, each 3x16x19 inches, consisted of over 100 species of the more injurious and more beneficial insects. The cases were arranged on a special table and were surrounded most of the time by a group deeply interested in learning about the common pests they had been obliged to fight so long. At the state fair nearly 2000 descriptive catalogues were distributed to those showing marked interest in the collection, and this number represents only a small proportion of those who looked at the collection, for

many, knowing little or nothing of its nature, were content with a glance or two. At the Oswego county fair the interest was if anything more marked. There was in constant attendance at each fair a member of the official force for the purpose of answering questions and explaining the more important features of the collection. Thus information was disseminated through the examination of insects and their work and by personal explanations, and all was supplemented by the distribution of a small catalogue giving in brief form the more striking characteristics of the insect and in a word outlining the method of keeping it in check.

The following extracts will give an idea of the interest taken in this new departure:

This exhibit, which is made under the auspices of the University of the State of New York, is attracting much attention, both from the mere sight seeker and from the practical farmer Mr G. W. J. Angell, who is in charge of the greater New York exhibit in Machinery hall . said: "I trust that this exhibit of insects is but an entering wedge, and will be greatly enlarged at future state fairs The heavy annual loss to the farmers and lumbermen of our state from the depredations of insect enemies runs high into the millions. The ability to differentiate between those creatures which are injurious and those directly or indirectly beneficial, and how best to prevent the ravages of the former, is as necessary to the successful farmer as the knowledge of the comparative values and the use of modern agricultural machinery. An insect, which today from its rarity is comparatively harmless to crops, may next year, from a sudden increase in its numbers, become a most destructive pest, and only by a knowledge of its life history and of the critical stage in its development, when the proper insecticides are most potent, can the threatened danger be averted

The handy little pocket catalogue of the present exhibit . . . gives descriptions of some 75 of the commoner injurious insects with the proper remedies to be used against their attacks, and is one of the most valuable features of the exhibit. Some of the insects which are directly beneficial are also noted, such as the various silk worms, both native and exotic, and the bees which carry pollen from flower to flower, without whose labors many of our most valuable plants would become extinct."—*Evening herald*, Syracuse, 7 Sep.

A new and valuable exhibit in Floral hall was a collection of 82 noxious and beneficial insects . . . probably the first attempt to bring the latest results of entomological science before the people at a state fair. The specimens were admirably arranged in cases, showing their successive changes and samples of their work on bark, wood and leaves They were constantly surrounded by observers, many drawn perhaps by the star of the season, the kissing bug, Opsicoetus personatus, but many fruit and shade tree growers were specially delighted with this opportunity to study the life history of pests whose ravages have been so sorely felt. The value of economic entomology can not better be made known than by thus bringing such exhibits before the people We trust that it may become a regular feature of future fairs. The exhibit has

already been asked for by the Oswego county fair. A neat little vest pocket catalogue of 28 pages briefly describes the insects, with treatment, which is worthy of careful preservation and study.—*Country gentleman*, 14 Sep. p 738

Another evidence of the value of the collection as an educator is found in the more recent request from F. E. Dawley, director of farmers institutes, that these insects be exhibited at a number of institutes in connection with a lecture. The catalogue is republished below in order to give a fuller idea of the scope and character of the exhibit.

FRUIT TREE INSECTS

1 **Apple tree tent caterpillar** (Clisiocampa americana). Conspicuous web tents in forks of apple and cherry trees contain hairy caterpillars with a white stripe along the back Cocoons spun the last of May, the light brown moths flying in June. Eggs, in belts encircling the smaller twigs, remain unhatched till spring.

Treatment: remove and destroy eggs or young in nests. Spray foliage of infested trees with poison in early spring.

2 **Cigar case bearer** (Coleophora fletcherella). Small caterpillars in cigar shaped cases feeding on buds and foliage of apple.

Treatment: spray infested trees with poison in early spring.

3 **Pistol case bearer** (Coleophora malivorella). Small caterpillars in pistol shaped cases feeding on the young leaves and opening flowers of the apple.

Treatment: spray infested trees with the poison in early spring.

4 **Apple leaf Bucculatrix** (Bucculatrix pomifoliella). White, ribbed cocoons about 1/4 in. long may be seen in clusters on smaller limbs of infested trees. The small larvae mine the leaves and later feed externally.

Treatment: spray infested foliage with poison in early June.

5 **Rose beetle** (Macrodactylus subspinosus). Greenish yellow beetles about 3/8 in. long appear in swarms in May and attack the foliage of various trees and vines.

Treatment: spray beetles with 1/2 pound whale oil soap to 1 gal. water, dust vines with ashes, etc.; handpicking.

6 **Apple tree borer** (Saperda candida). "Sawdust" or diseased bark and beneath the latter, legless, white, round headed borers. The brown beetles, striped with white, about 1 in. long, occur from June to August.

Treatment: protect base of tree with wire netting. Dig out the young borers in the fall. Cut and burn badly infested trees.

7 **Pear midge** (Diplosis pyrivora). Dwarfed, deformed fruit drops early, and within occur thick bodied, pale yellow maggots.

Treatment: destroy infested fruit.

8 **Peach bark borer** (Scolytus rugulosus). Bark of affected trees punctured with many small, circular holes, made by brownish black beetles less than ⅛ in. long. Inner portions of bark and sap wood filled with burrows.

Treatment: burn badly infested trees. Apply carbolic soap wash to trunks and limbs in early spring.

9 **Pear blight beetle** (Xyleborus dispar). Bark of affected trees punctured with many small, circular holes made by dark brown beetles about ⅛ in. long. Inner portions of bark and sap wood filled with burrows.

Treatment: burn badly infested trees.

10 **17 year cicada** (Cicada septendecim) Slit and broken twigs with wilting leaves are characteristic work of this insect, but unless the trees are small not much damage is done.

Prevention: avoid setting out trees in last few years before cicadas are due.

11 **Apple tree bark louse** (Mytilaspis pomorum). Bark infested with brownish scales shaped like oyster shells. Occurs on many other trees. Winter passed as white eggs under old scales, the young appearing about June 1.

Treatment: spray young with kerosene emulsion or whale oil soap solution.

12 **Scurfy bark louse** (Chionaspis furfurus). The whitish, scurfy scales occur on the bark of fruit trees. The purplish eggs remain under old scales all winter, the young appearing about June 1.

Treatment: spray young with kerosene emulsion or whale oil soap.

13 **San José scale** (Aspidiotus perniciosus). A small circular scale not readily seen unless very abundant. Infests many trees and shrubs. The specimens show variations in the appearance of the scales and how it may be disseminated by budding. Young appear from early June till cold weather.

Treatment: destroy badly infested trees, specially if young, and spray others thoroughly with kerosene emulsion or whale oil soap solution. Fumigate with gas.

14 **English oyster scale** (*Aspidiotus ostreaeformis*). Resembles San José scale in appearance and like it infests fruit trees. Occurs in several localities in this state and should be guarded against.

Treatment: spray infested trees with kerosene emulsion or whale oil soap solution. Fumigate with gas.

15 **Putnam's scale** (*Aspidiotus ancylus*). Resembles the two preceding species, but is less injurious. Attacks various trees.

Treatment: same as preceding.

SMALL FRUIT AND VINE INSECTS

16 **Currant worm** (*Pteronus ribesii*). Greenish, black-dotted saw fly larvae feeding on currant leaves in May, the common currant worm.

Treatment: spray with hellebore or poison.

17 **Currant span worm** (*Diastictis ribearia*). Yellowish, black-dotted span worms feeding on leaves in May and June.

Treatment: spraying with poison, or handpicking.

18 **Currant stem borers** (*Sesia tipuliformis, Janus integer, Tenthredo rufopectus*). The caterpillars boring in the woody stems are sesians. The maggots working in the tender tips may be either those of *Janus* or *Tenthredo*.

Treatment: burn stems infested with sesians and the wilting tips infested by the others.

19 **Raspberry gouty gall beetle** (*Agrilus ruficollis*). Irregular swellings on canes are produced by larvae of this pest.

Treatment: cut and burn infested canes during winter or early spring.

20 **Light-loving grape vine beetle** (*Anomala lucicola*). Brownish or black beetles about 3/8 in. long, resembling a small June beetle.

Treatment: dust vines with lime. Collect and destroy beetles.

21 **Spotted grape vine beetle** (*Pelidnota punctata*). Brown, black-spotted beetles about 1 in. long, resembling a June beetle.

Treatment: handpicking.

22 **Grape vine flea beetle** (*Haltica chalybea*). Greenish or blue beetles about 1/8 in. long, feeding on buds, or brownish, black dotted larvae about 1/2 in. long, skeletonizing leaves.

Treatment: spray with poison, using a large amount on buds, less for young on leaves.

23 **Grape vine plume moth** (Oxyptilus periscelidactylus). Small, greenish, hairy caterpillars webbing together terminal leaves.

Treatment: pick and destroy infested tips.

24 **Eight spotted forester** (Alypia octomaculata). Reddish, black-ringed caterpillars about ½ in. long feeding on grape vine and Virginia creeper in spring.

Treatment: handpicking; spray with poison.

25 **White flower cricket** (Oecanthus niveus) Series of punctures in twigs of various kinds are made by this insect for the reception of its eggs. Injury is usually too little to call for remedial measures, specially as the insects are predaceous and therefore beneficial.

SHADE TREE PESTS

26 **White-marked tussock moth** (Notolophus leucostigma). Beautiful caterpillars having three black plumes, four yellow or white tufts, a coral red head, and body marked with black and yellow. Defoliate horse chestnut, elm and other shade trees. Winter passed in white, frothy egg masses, the caterpillars hatching the latter part of May and spinning up about a month later, the moths appearing in July. Two broods about New York city, but one farther north.

Treatment: destroy eggs or spray foliage of infested trees with poison.

27 **Forest tent caterpillar: maple worm** (Clisiocampa disstria). Foliage of maple and fruit trees eaten in May and June by hairy blue-headed caterpillars with silvery dots along the back. Cocoons spun in June, the brown moth flying in July. Eggs in belts encircling smaller twigs, remain unhatched till spring.

Treatment: destroy eggs; kill the caterpillars when massed on trunk and limbs; spray foliage of infested trees with poison; collect and destroy cocoons.

28 **Pigeon Tremex** (Tremex columba). Adults frequently known as "horn tails", are usually found in July around diseased and dying tree trunks. The young borers occur near the surface, but full grown ones may make their way to the center of even large trees. Not usually very injurious.

Treatment: cut and burn badly infested trees.

29 **Lunate long sting** (Thalessa lunator). Brownish, wasp-like insects with yellow markings and a slender ovipositor or "tail" 2 to 4 in. long. Frequenting elms and maples infested by the pigeon

Tremex and occasionally found with the ovipositor stuck in the wood. The white legless grubs attach themselves to the borers and suck their life out. *This insect should* therefore *be protected.*

30 **Cottony maple tree scale insect** (Pulvinaria innumerabilis). Under side of smaller limbs sometimes festooned with this cottony insect, though more frequently it occurs in small masses. Young appear in July.

Treatment: spray young with kerosene emulsion or whale oil soap solution. Brush or scrape off and destroy old scales.

31 **Sugar maple borer** (Plagionotus speciosus). Diseased or loose bark and exposed dead wood indicate the work of this pest. The grubs frequently cause serious injury by running transverse burrows just beneath the bark. The stout, black beetles, about 1 in. long with bright yellow markings, occur from June to August.

Treatment: burn badly infested trees. Dig out the young borers in the fall. Protect trees with carbolic soap wash from June to August.

32 **Maple tree pruner** (Elaphidion villosum). Small limbs of maple, oak and other trees nearly eaten off by an insect and dropping in September, usually contain the burrows of this species.

Treatment: collect infested limbs on the ground and burn before spring.

33 **Elm leaf beetle** (Galerucella luteola). Irregular round holes eaten in young foliage followed by the grubs gnawing the under portions of the leaves, which then dry and turn brown. The yellowish, black-striped beetles, about ¼ in. long, appear in early spring and lay eggs in May. The grubs feed in June, changing to yellow pupae the latter part of the month. A second brood occurs in July and extends into September. Known in this state only on Long Island and in the Hudson river valley.

Treatment: spray foliage of infested trees with poison, which *must be applied* to *under surface* of the leaf in order to kill the grubs. Kill larvae and pupae on and near trunks of the trees.

34 **Elm bark louse** (Gossyparia ulmi). Adult females in June appear like clusters of small lichens on the under side of the smaller limbs of European elms. Young emerge in July.

Treatment: spray with kerosene emulsion or whale oil soap solution.

35 **Elm borer** (Saperda tridentata). Diseased or dead bark, and in inner portions white, flattened, legless grubs, which frequently

cause considerable injury. Beetles appear from early May till latter part of June.

Treatment: cut and burn badly infested trees. Protect valuable trees with carbolic soap wash during May and June.

36 **Elm snout beetle** (Magdalis barbita). Thick, fleshy, legless grubs working in inner bark of elm. Follows attack by the elm borer and occasionally is very abundant.

Treatment: burn badly infested trees and keep others vigorous.

37 **Fall web worm** (Hyphantria cunea). Web tents in July and August inclosing leaves on the tips of branches, the eaten foliage turning brown. Attacks many trees.

Treatment: destroy webs and their inhabitants or spray foliage of affected limbs with poison.

38 **Bag worm** (Thyridopteryx ephemeraeformis). Defoliated evergreens and other trees are found infested with curious cocoons or bags containing caterpillars in late summer and fall. Occur in vicinity of New York city.

Treatment: collect and destroy bag worms or spray with poison.

39 **Leopard moth** (Zeuzera pyrina). Whitish, black-spotted caterpillar making large burrows in various trees. A bad pest about New York city.

Treatment: dig out young borers. Kill others with carbon bisulfid. Burn badly infested trees.

40 **Bronze birch borer** (Agrilus anxius). If injured bark is examined, a slender flat-headed grub will be found running burrows in all directions in the inner portions. White and other birches are attacked. Very injurious at present in Buffalo. Beetles appear in June.

Treatment: cut and burn badly infested trees.

GARDEN INSECTS

41 **Colorado potato beetle** (Doryphora 10-lineata). Stout yellowish beetles with black striped wing covers appear in early spring, feed, and deposit yellowish eggs in clusters on under surface of leaves. The reddish, black-marked grubs also devour the foliage.

Treatment: handpicking; spray vines with poison.

42 **Squash vine borer** (Melittia satyriniformis). Wilting of one or more runners is caused by a whitish caterpillar boring in the stem near the root.

Treatment: slit the softer, infested portions, remove the borers and cover the wounded part with earth. Protect young plants with netting.

43 **Striped cucumber beetle** (Diabrotica vittata). Yellow beetles about ¼ in. long, striped with black, occur in numbers on cucumber and squash vines.

Treatment: protect young vines with netting. Dust vines with ashes, plaster of paris, etc. Poison trap crop of squash.

44 **Cucumber flea beetle** (Epitrix cucumeris). Brownish, gnawed spots on leaves made by numerous black jumping beetles about $\frac{1}{16}$ in. long.

Treatment: spray vines with bordeaux mixture.

45 **Squash bug** (Anasa tristis). Wilting leaves with their under surface infested by greenish young or by the large, grayish brown stink bugs about ¾ in. long.

Treatment: place chips and similar shelters near the vines and kill daily the bugs collected underneath. Crush the brownish eggs on under surface of the leaves.

46 **Common asparagus beetle** (Crioceris asparagi). Slate colored grubs about ⅓ in. long or yellowish and bluish green beetles about ¼ in. long eating the more tender portions of the plants. Occurs on Long Island, in Hudson river valley and in the lake regions of the western part of the state.

Treatment: spray affected plants with poison.

47 **12 spotted asparagus beetle** (Crioceris 12-punctata). Slate colored grubs about ⅓ in. long or stout, nearly cylindric red beetles with 12 black spots, eating the more tender portions of the plant. Known to occur in the state at Albany, Newark, Brighton, East Amherst, Buffalo and Crosby.

Treatment: spray affected plants with poison.

48 **Flea beetle on sugar beets** (Systena frontalis). Ragged holes and brown spots made by small, jumping, black, red-headed beetles about $\frac{3}{16}$ in. long.

Treatment: spray affected plants with poison or bordeaux mixture.

49 **Blister beetles** (Epicauta cinerea, E. vittata). Feeding in July and August on the foliage of potato and other plants, cylindric, soft beetles about ⅝ in. long and black and gray, or black striped with yellow.

Treatment: as the grubs of these beetles are known to feed on the eggs of grasshoppers and are therefore beneficial, the adults should be destroyed, by spraying affected plants with poison or by beating the insects into pans containing water and kerosene, only when necessary.

50 **Bumble flower beetle** (Euphoria inda). Brownish mottled beetles about 5/8 in. long feeding in ears of green corn, attacking peaches.

Treatment: handpicking.

51 **Stalk borer** (Hydroecia nitela). Wilting potato vines and within a brown, white-striped active caterpillar about 1 in. long. Attacks many thick stalked herbaceous plants.

Treatment: burn infested stalks before September.

52 **Variegated cut worm** (Peridroma saucia). Stout, brownish cut worms with obscure markings and about 1½ in. long. Injurious to various garden plants. Its operations on carnations in a greenhouse are shown.

Treatment: place poisoned baits near plants to be protected.

53 **Zebra caterpillar** (Mamestra picta). Brilliantly marked black and yellow, red-headed caterpillar about 2 in. long frequently found on cabbage, beets and other garden crops.

Treatment: spray affected plants with poison, hellebore or pyrethrum water.

54 **Cabbage butterfly** (Pieris rapae). Large irregular holes eaten in cabbage by a greenish caterpillar. White butterflies abundant in the field.

Treatment: capture the butterflies with nets. Spray young cabbage with poison, older ones with hellebore or pyrethrum water. Dust with lime.

55 **Cabbage thrips** (Thrips tabaci). Cabbage and lettuce show white spots as though blasted, caused by minute yellowish or brown insects.

Treatment: spray affected plants with kerosene emulsion or a soap solution.

56 **Tarnished plant bug** (Lygus pratensis). Small yellowish and black bugs about ¼ in. long, frequenting many plants and injuring most garden crops and some trees.

Treatment: handpicking or dusting with ashes. Burn all rubbish in the fall.

57 **Four lined leaf bug** (Poecilocapsus lineatus). Yellowish bugs with four black stripes and about $\frac{5}{16}$ in. long frequenting various plants and injuring some considerably.

Treatment: dust affected plants with ashes. Spray young with kerosene emulsion. Cut and burn tips of bushes containing eggs.

GRASS INSECTS

58 **Army worm** (Leucania unipuncta). Brownish, white-striped caterpillars about 2 in. long devouring grasses and allied plants.

Treatment: confine by ditching, kill with poisoned baits. Prevent their occurrence by clean culture.

59 **White grubs** (Lachnosterna fusca, Allorhina nitida). Fleshy, white, brown-headed grubs severing grass roots and those of other plants. Allorhina occurs in vicinity of New York city.

Treatment: spray badly infested areas liberally with kerosene emulsion just before a rain. Dig and destroy the grubs.

60 **Grasshoppers.** A number of species attack various crops.

Treatment: place poisoned baits near crops to be protected.

HOUSEHOLD INSECTS

61 **House fly** (Musca domestica). Easily recognized as the common fly around houses.

Treatment: exclude with screens. As it breeds in manure and garbage, keeping this material cleaned up or inaccessible to flies will reduce their numbers.

62 **Bed bug** (Acanthia lectularia), A flattened, reddish insect about ¼ in. long frequenting houses, specially those affording numerous cracks where it can find shelter and where uncleanliness prevails.

Treatment: apply benzine, kerosene or other petroleum oil to crevices in infested beds. Corrosive sublimate may be used in same manner. Fumigation with sulfur is valuable wherever possible.

63 **Kissing bug: masked bed bug hunter** (Opsicoetus personatus). A brownish or black insect about ¾ in. long. It is attracted by lights, and its young, which conceals itself by a covering of

lint, etc. is said to have a partiality for bed bugs. Not usually harmful, though it can inflict a severe bite or "sting."

Treatment: screens should exclude it most effectually.

64 **Buffalo carpet beetle** (Anthrenus scrophulariae). Larvae easily recognized by their shaggy appearance, being provided with coarse bristles along the sides and at the posterior extremity of the body. The beetles are about 1/8 in. long, black, marked with white and a red line down the middle of the back, widening into three projections.

Treatment: use rugs or matting in place of carpet whenever possible. Infested carpets should be taken up and sprayed with benzine and the cracks in the floor should be filled with plaster of paris before relaying the carpet.

65 **Black carpet beetle** (Attagenus piceus). Light brown cylindric larva with a long "tail" of slender hairs. The adult is a small oval black beetle nearly 3/16 in. long. This species has a decided taste for feathers.

Treatment: same as for the preceding.

66 **Little red ant** (Monomorium pharaonis). The common yellowish red ant about 3/16 in. long that frequents houses in such numbers at times.

Treatment: destroy colony with carbon bisulfid when possible. Attract to sponge filled with sweetened water and kill the collected ants by dropping them in hot water.

67 **Bacon beetle** (Dermestes lardarius). Dark brownish beetle about 5/16 in. long with yellowish band on wing covers. Larva brown, hairy, about 5/8 in. long. Both adult and larva attack bacon, meat, etc.

Treatment: cleanliness and excluding insects from the food.

68 **Croton bug** (Phyllodromia germanica). The smaller, light brown roach about 3/4 in. long found in houses.

Treatment: roach poisons, such as Hooper's fatal food. Paris green with sugar has been used successfully, but is a dangerous poison. Fumigate with sulfur where possible. Entice the bugs to enter vessels partly filled with stale beer, from which no escape is provided.

69 **Cockroach** (Periplaneta orientalis). The larger dark brown species an inch or more long, found in dwellings.

Treatment: same as for the croton bug.

INSECTS AFFECTING STORED GRAINS AND LEGUMINOUS SEEDS.

70 **Grain moth** (Sitotroga cerealella). A small caterpillar about $\frac{7}{16}$ in. long working in various grains and producing a whitish moth with a wing spread of a little over ½ in.

Treatment: fumigate infested grain with carbon bisulfid and treat suspected granaries in the same manner.

71 **Saw toothed grain beetle** (Silvanus surinamensis). A small, brown, slender beetle about ⅛ in. long found infesting cereals and dried food products.

Treatment: fumigate infested cereals with carbon bisulfid and allow none of its food to lie long undisturbed.

72 **Indian meal moth** (Plodia interpunctella). Whitish caterpillar living in indian meal and other cereals and fastening the particles of grain together with a web. Moth with the outer two thirds of fore wings reddish brown, the inner portion and hind wings light gray.

Treatment: fumigate infested food with carbon bisulfid.

73 **Confused flour beetle** (Tribolium confusum). A rather stout, shining, reddish brown beetle about $\frac{3}{16}$ in long. Very prolific and frequently causes considerable injury.

Treatment: fumigate with carbon bisulfid and clean infested localities.

74 **Bean weevil** (Bruchus obtectus). Small grayish brown beetles about ⅛ in. long breeding in dry beans and eating out numerous holes.

Treatment: fumigate beans in all infested localities with carbon bisulfid as soon as threshed.

75 **Pea weevil** (Bruchus pisorum). Brownish or black beetles with indistinct white markings, about $\frac{3}{16}$ in. long, infesting peas.

Treatment: same as for bean weevil.

BENEFICIAL INSECTS

76 **Silk worm** (Bombyx mori). Showing eggs, larva, single and double cocoons, those from which moths have emerged, one from which the silk has been reeled, male and female moths, raw silk; also several other species of silk-producing moths.

77 **Pollen carriers.** A great many insects convey pollen from flower to flower and in certain cases there are some very interesting adaptations. Some of the more common pollen carriers are honey bees,

bumble or humble bees, other bees, wasps, flower or Syrphus flies and many others.

78 **Lady bugs.** Certain species are valuable agents in controlling plant lice, which they and their young feed on. Some forms prey on scale insects.

79 **Soldier beetles** (Chauliognathus species). The beetles are among the pollen carriers and the larvae prey on the worm of the codling moth.

80 **Syrphus flies.** The adults are usually seen among flowers, but the work of their frequently brightly colored larvae in reducing the number of plant lice is not so well known. These beneficial maggots are nearly conical and may be found among colonies of plant lice.

81 **Spined soldier bug** (Podisus spinosus). Represents a number of species which prey on other insects. This one feeds on a number of common pests, such as the potato beetle, elm leaf beetle and asparagus beetle grubs.

82 **Red tailed Tachina fly** (Winthemia 4-pustulata). Valuable parasite of army worm, tent caterpillar and several other pests.

LIST OF PUBLICATIONS OF THE ENTOMOLOGIST

The following is a list of the principal publications of the entomologist during the year 1899. 95 are named, with title,[1] place and time of publication and a summary of the contents of each. Volume and page numbers are separated by a colon, the first superior figure tells the column, and the second the exact place in the column in ninths; e. g. 63 : 993[23] means vol. 63, p. 993, column 2, beginning in the third ninth, i. e. about one third of the way down:

Scale on magnolia and Euonymus. (American gardening, 29 Oct. 1898, 19: 742[28])

Lecanium tulipiferae Cook and Chionaspis euonymi Comst. from Fishkill on the Hudson are identified and remedies given.

Beneficial bugs. (Country gentleman, 3 Nov. 1898, 63: 868[44])

The nine pronged wheel-bug, Prionidus cristatus Linn. is figured, briefly described and its beneficial habits given. The masked bed bug hunter, Opsicoetus personatus Linn. is similarly treated and the protection of both forms is urged.

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[1] Titles are given as published and in some instances they have been supplied by editors.

A pernicious elm borer. (Country gentleman, 3 Nov. 1898, 63: 869[16]. New England farmer, 26 Nov. 1898, v.76 no.48 p.2)

Describes a serious attack on elms at Berlin Mass. by the elm borer, Saperda tridentata Oliv. and its associates, Neoclytus erythrocephalus Fabr. and Magdalis barbita Say. Several preventives and remedies are given.

Look out for canker worms! (Country gentleman, 10 Nov. 1898, 63: 894[15])

Recent injuries by canker worms are mentioned and the life history of the lime tree winter moth, Erannis tiliaria Harr. received from Gouverneur N. Y., is given.

Hessian fly. (Country gentleman, 17 Nov. 1898, 63: 906[38])

Wheat turning yellow in Michigan is probably caused by Cecidomyia destructor Say.

Elm borer. (Country gentleman, 17 Nov. 1898, 63: 906[46]–7[11])

An unthrifty elm with loose bark, at Utica N. Y. is probably infested by Saperda tridentata Oliv. and species usually associated with it. Several remedies are given.

Grape vine leaf hopper. (Country gentleman, 17 Nov. 1898, 63: 913[31])

Insects from Lahaska Pa. are identified as Typhlocyba comes Say, figured and briefly treated.

Exterminating potato bugs. (Country gentleman, 17 Nov. 1898, 63: 913[41]–14[14])

In response to a report that the potato beetle is kept in subjection by its natural enemies at a locality in Lycoming co. Pa. it is stated that this is out of the ordinary experience. This pest has a large number of insect enemies. One of the more important, Lebia grandis Hentz, is figured and noticed briefly. It probably would not pay to distribute enemies of the potato beetle.

Notes on some insects of the year in the state of New York. (U. S. department of agriculture, division of entomology. Bulletin 17, new series [Rec'd 5 Dec. 1898] p.16–23)

The following species are noticed:

White-marked tussock moth, Notolophus leucostigma Abb. & Sm.; elm leaf beetle, Galerucella luteola Müll.; cherry or pear tree slug, Eriocampoides limacina Retz; Byturus unicolor Say; maple tree pruner, Elaphidion villosum Fabr; Galerucella cavicollis Lec.; apple tree tent caterpillar, Clisiocampa americana Fabr.; forest tent caterpillar, Clisiocampa disstria Hübn.; zebra caterpillar, Mamestra picta Harr.; Xylina laticinerea or X. cinerea Riley [X. antennata Walk.]; elm leaf miner; maple tree scale insect, Pulvinaria innumerabilis Rathv.; Lecanium armeniacum Craw.; Lecanium cerasifex Fitch; San José scale, Aspidiotus perniciosus Comst.

Bean weevil. (Country gentleman, 8 Dec. 1898, 63 : 966[17])

Planting uninfested seed on fresh soil is recommended and the treatment the entire crop in infested localities with carbon bisulfid is advised.

Carbon bisulfid. (Country gentleman, 8 Dec. 1898, 63 : 966[37])

Directions are given for treating grain with carbon bisulfid.

Insects from lily pond. (American gardening, 10 Dec. 1898, 19 : 842[28])

The dragon fly nymphs submitted with the inquiry are predaceous. More probably the depredator on the lily buds was a caddice fly.

Controlling city pests. (Albany evening journal, 10 Dec. 1898, p. 6; *also in* Troy daily times, 10 Dec. 1898; Argus [Albany] 11 Dec. 1898, p. 7; Sunday press [Albany] 11 Dec. 1898, p. 9; Troy budget, 11 Dec. 1898, p. 9)

A general notice recommending the collection of the egg masses of the white-marked tussock moth, Notolophus leucostigma Abb. & Sm.

A destructive borer. (Country gentleman, 15 Dec. 1898, 63 : 993[12])

Notices a very destructive borer, Agrilus anxius Gory, which has seriously injured birches at Buffalo N. Y. The European Agrilus betuleti Ratz. is mentioned.

Everlasting San José scale. (Country gentleman, 15 Dec. 1898, 63 : 993[23])

The recent prohibition of the importation of American nursery stock into France is probably the outcome of resolutions adopted by the Society of agriculturists in France. Mention is made of the interest excited by Aspidiotus perniciosus Comst. in this country and abroad.

Spray barrel on wheels. (Country gentleman, 12 Jan. 1899, 64 : 26[27])

Gives directions for mounting a barrel on wheels and suggests the use of a stone-boat or drag.

14th report on the injurious and other insects of the state of New York for the year 1898. Albany, University of the State of New York, Dec. 1898 [issued 12 Jan. 1899] 150 p. 9 pl. *Also as* Report of the state entomologist for 1898 (New York state museum 52d report, for 1898. Bulletin, v. 5, no. 23. Dec. 1898 [issued 12 Jan. 1899])

Contents

[1] A general account and bibliography is given of each.

Circular to those interested in entomology. (Issued 6 Feb. 1899. Republished in Argus [Albany] 12 Feb. 1899)

Invites the public to cooperate with the department in the observation of insects.

Squash, melon and cucumber bugs. (Country gentleman, 16 Feb. 1899, 64: 128[12])

A brief general account treating of the following insects: Squash bug, Anasa tristis DeGeer; squash vine borer, Melittia satyriniformis Hübn. (syn. M. cucurbitae Harr.); pickle and melon worms, Margaronia nitidalis Cram. and M. hyalinata Linn.; striped cucumber beetle, Diabrotica vittata Fabr.; northern lady bird, Epilachna borealis Fabr.; cucumber flea beetle, Epitrix cucumeris Harr. and the melon plant louse, Aphis gossypii Glover.

Arsenical poisons. (Country gentleman, 16 Feb. 1899, 64: 128[27])

Discusses several arsenical compounds and recommends the use of arsenate of lead.

13th report on the injurious and other insects of the state of New York for 1897, by J. A. Lintner. Albany, University of the State of New York, 1898 [issued 18 Feb. 1899] 64p., 2 pl. *Also as* Report of the state entomologist for 1897 (New York state museum 51st report for 1897)

Contents

[Introduction to address before the eastern New York horticultural society] (Country gentleman, 2 Mar. 1899, 64: 174[24])

The extension of the upper austral life zone along the Hudson river, and the unexcelled facilities of the stream for the transportation of insects, render this region very interesting and a study of its fauna of great importance. Isolation of orchards is recommended wherever practicable. A few observations on the San José scale are given.

Injurious shade tree insects, with special reference to the elm leaf beetle. Address before the Troy scientific association, 6 Mar. 1899. (Portion published in the Troy times, 7 Mar. 1899. *Also in* Argus [Albany] 12 Mar. 1899, p. 9)

After the work of the elm borer, Saperda tridentata Oliv., and the elm bark louse, Gossyparia ulmi Geoff., is briefly characterized, the elm leaf beetle, Galerucella luteola Müll., is treated under the following heads: injuries, life history and habits, ineffectual measures, spraying with poison, importance of thorough work, approximate cost and the necessity of municipal action.

1 A bibliography and general account is given of each.

Injurious insects of the Hudson river valley. Portion of an abstract of the address delivered before the eastern New York horticultural society. (Rural New Yorker, 18 Mar. 1899, 58: 198[21])

Nearly the same as the above.

Insect enemies of our shade trees and their control, with special reference to the elm leaf beetle. Address delivered before the Albany institute, 4 Ap. 1899. (Extracts from, in Argus [Albany] 5 Ap. 1899, p.6; Press and Knickerbocker [Albany] 5 Ap. 1899, p.8)

Describes the local situation briefly; otherwise nearly same as the address before the Troy scientific association.

Scale on Japan quince. (American gardening, 15 Ap. 1899, 20: 284[28])

Identifies scurfy bark louse, Chionaspis furfurus Fitch, and gives remedies.

Myriapods and mites. (American gardening, 29 Ap. 1899, 20: 321[15])

Spraying with kerosene emulsion is advised for these soil inhabiting forms.

Box elder plant bug. (American gardening, 29 Ap. 1899, 20: 321[16])

Excluding the bugs, Leptocoris trivittatus Say, from the houses is recommended.

Protect the trees from caterpillars. (Argus [Albany] 30 Ap. 1899, p.20. Also in Sunday press [Albany] of same date)

Removing and burning the eggs of the white-marked tussock moth, Notolophus leucostigma Abb. & Sm. is advised.

Ants. (Country gentleman, 4 May 1899, 64: 346[44])

Gives several remedies for ants in houses.

Elm leaf beetle at work. (Troy daily times, 4 May 1899; Troy daily press, 4 May, p.8; Argus [Albany] 5 May, p.4; Times-Union [Albany] 4 May, p.3; Ballston daily journal, 5 May, p.2; Fishkill standard, 6 May, p.2; Rough notes [Valatie N. Y.] 5 May, p.2; Newburgh journal, 5 May, p.2; Sunday press [Albany] 7 May, p.15; Poughkeepsie daily eagle, 9 May, p.8; New York farmer, 11 May, p.4; Rhinebeck gazette, 13 May, p.1; Eastern New York horticulturist, 1899, v.2 no.4 p.13)

States that the beetles, Galerucella luteola Müll., have appeared in numbers and advises spraying at once.

Collection, preservation and distribution of New York insects. (Bulletin New York state museum, v.6 no.26, Ap. 1899 [Issued 6 May] 36p. 29 fig.)

Contents

Forest tent caterpillar. (Country gentleman, 11 May 1899, 64:367[11])

Identifies eggs of Clisiocampa disstria Hübn. and gives several remedies.

Curious insect tastes. Country gentleman, 11 May 1899, 64:368[35]; New York farmer. 18 May. p. 8)

Describes work of the black carpet beetle, Attagenus piceus Oliv. in whalebone cane, that of the bristle tail, Lepisma domestica Pack. [Thermobia furnorum Prov.] among papers, mentions the food habits of the cigarette beetle, Lasioderma serricorne Fabr. and refers to lead boring by several insects, specially Sitodrepa panicea Linn.

Cut worms on carnations. (Country gentleman, 11 May 1899, 64:368[44])

Records an attack by Peridroma saucia Hübn. on carnations in a greenhouse and recommends poisoned bait.

Look out for caterpillars. (Country gentleman, 11 May 1899, 64:368[46])

General warning is given in regard to the tent caterpillars, Clisiocampa americana Fabr. and C. disstria Hübn.

[Remedies for tent caterpillars] (Daily Saratogian, 15 May 1899, p. 2)

Extracts from 14th report regarding treatment of these pests and the use of insecticides.

[Remedies for forest tent caterpillar.] (Daily Saratogian, 17 May 1899, p.3 (a portion of the report); 19 May (entire report); also portions in special circular issued by direction of the street commissioners of Saratoga Springs)

Recommends clearing of the trees by individual effort. The caterpillars should be brushed, shaken or burned from the trees and prevented from ascending by the use of cotton bands.

Pests on fruit trees. (Country gentleman, 25 May 1899, 64: 406[45])

Identifies oblique-banded leaf roller, Cacoecia rosaceana Harr.; bud moth, Tmetocera ocellana Schiff.; and cherry aphis, Myzus cerasi Fabr. and gives remedies. Adalia bipunctata Linn. is also noticed as an aid in the destruction of pests.

[Voluntary entomologic service of New York.] (Country gentleman, 25 May 1899, 64: 414[16]; New York farmer, 25 May, p.5; American agriculturist, 27 May, 63: 682[25])

Summary of reports from voluntary observers.

Value of spraying. (Argus [Albany] 29 May, 1899, p.4)

Notices the prompt results obtained in spraying maples infested with forest tent caterpillars, Clisiocampa disstria Hübn.

[Voluntary entomologic service of New York.] (Country gentleman, 1 June 1899, 64: 426[34]; New York farmer, 1 June, 1899, p.5)

Summary of reports from voluntary observers.

Plant lice. (Country gentleman, 1 June 1899, 64: 430[14])

Identifies Aphis rumicis Linn. on Euonymus and gives life history and remedies.

Bark louse and Phytoptus. (Country gentleman, 1 June 1899, 64: 430[17])

Identifies Mytilaspis pomorum Bouché, and Phytoptus quadripes Shim. on silver maple and indicates remedies.

Elm leaf beetle. (Troy budget, 4 June 1899, p.2)

Portions of bulletin on shade tree pests are reproduced, as is also a circular letter urging immediate spraying.

Shade tree pests in New York state. (Bulletin New York state museum v.6 no.27, May, 1899 [issued 5 June] 26p. 8 fig. 5 pl.)

Contents

[Voluntary entomologic service of New York] (Country gentleman, 8 June 1899, 64: 447[22]; New York farmer, 8 June 1899, p. 4)

Summary of reports from voluntary observers.

Forest tent caterpillars. (Country gentleman, 8 June 1899, 64: 448[44])

Gives remedies for these caterpillars, Clisiocampa disstria Hübn. when they occur in numbers on shade trees.

[Voluntary entomologic service of New York] (Country gentleman, 15 June 1899, 64: 466[32]; New York farmer, 15 June 1899, p. 4)

Summary of reports from voluntary observers.

Bordeaux mixture. (Country gentleman, 15 June 1899, 64: 470[14])

This fungicide should cover the plant.

Tent caterpillars. (Country gentleman, 15 June 1899, 64: 470[16])

Recommends arsenical poisons for controlling these pests.

Forest tent caterpillars. (Country gentleman, 15 June 1899, 64: 474[31])

Protection and encouragement of native birds is probably the most practical way of keeping Clisiocampa disstria Hübn. under control in woodlands.

17 year cicada. (Union Springs advertiser, 15 June 1899, p. 2; Cazenovia republican, 15 June 1899, p. 1; Caledonia advertiser, 15 June, p. 2)

Brief notice of the appearance in western central New York of Cicada septendecim Linn.

Galls on maple leaves. (Country gentleman, 22 June 1899, 64: 486[24])

Galls of Phytoptus quadripes Shim. briefly described and treatment indicated.

[Voluntary entomologic service of New York] (Country gentleman, 22 June 1899, 64: 486[45]; New York farmer, 22 June 1899, p. 4)

Summary of reports from voluntary observers.

Kill the elm grubs. (Argus [Albany] 22 June 1899, p. 2)

Brief notice urging the destruction of the grubs of the elm leaf beetle, Galerucella luteola Müll. as they descend for pupation.

[Voluntary entomologic service of New York] (Country gentleman, 29 June, 1899, 64: 506[48]–7[13]; New York farmer, 29 June 1899, p. 4)

Summary of reports from voluntary observers.

Blister beetles. (Country gentleman, 6 July 1899, 64: 526[26])

Ash gray blister beetle, *Macrobasis unicolor* Kirby, from Aiken S. C. and the striped blister beetle, *Epicauta vittata* Fabr. are briefly characterized and remedies are given.

[Voluntary entomologic service of New York] (Country gentleman, 6 July 1899, 64: 526[44]; New York farmer, 6 July 1899, p. 4)

Abstract of reports from voluntary observers.

Cockscomb elm gall. (Rural New Yorker, 18 July 1899, 58: 497[15])

Colopha ulmicola Fitch identified and described.

[Voluntary entomologic service of New York] (Country gentleman, 13 July 1899, 64: 547[27]; New York farmer, 20 July 1899, p. 4)

Summary of reports from voluntary observers.

Kissing bugs. (Argus [Albany] 17 July 1899, p. 8; republished in part in Troy daily times, 18 July 1899)

States that many of the stories are exaggerations. The black corsair, *Melanolestes picipes* Her.-Sch. and the masked bed bug hunter, *Opsicoetus personatus* Linn. are briefly noticed as authors of some of the injuries reported.

[Voluntary entomologic service of New York] (Country gentleman, 20 July 1899, 64: 567[17]; New York farmer, 20 July 1899, p. 4)

Abstract of reports from voluntary observers.

[Voluntary entomologic service of New York] (Country gentleman, 27 July 1899, 64: 587[28]; New York farmer, 27 July 1899, p. 4)

Abstract of reports from voluntary observers.

Fall web worm. (Country gentleman, 27 July 1899, 64: 593[21])

Gives life history and remedies for *Hyphantria cunea* Drury.

Elm tree spraying. (Troy record, 29 July 1899)

Refutes the imputation that elms in New Haven Ct. and vicinity have not been sprayed, refers to the destructive work of the elm leaf beetle, *Galerucella luteola* Müll. in Albany and Troy, and states that thorough spraying is the only way of controlling the pest.

[Voluntary entomologic service of New York]. (Country gentleman, 3 Aug. 1899, 64: 606[47]–7[13])

Summary of reports from voluntary observers.

Striped blister beetle. (Country gentleman, 10 Aug. 1899, 64: 626[27])

Epieauta vittata Fabr. is identified and remedies are given.

Squash bug. (Country gentleman, 10 Aug. 1899, 64: 626[34])

Anasa tristis DeGeer is described and several methods of fighting it are mentioned.

Spined soldier bug. (Country gentleman, 10 Aug. 1899, 64: 626[37])

The beneficial habits of Podisus spinosus Dallas are described and some of the insect pests on which it preys are named.

Hessian fly. (Country gentleman, 10 Aug. 1899, 64: 628[47]–29[18])

A general account, dwelling mostly on remedies for and preventives of injury by Cecidomyia destructor Say.

[Voluntary entomologic service of New York] (Country gentleman, 10 Aug. 1899, 64: 634[44])

Abstracts from reports of voluntary observers.

[Elm leaf beetle in Troy] (Troy daily times, 12 Aug. 1899)

Declares that where the elms were sprayed thoroughly and at the proper time the results were very satisfactory.

Turnip pest. (Country gentleman, 17 Aug. 1899, 64: 646[14])

Recommends spraying with bordeaux mixture or paris green for the web caterpillar.

Elm leaf beetle. (Country gentleman, 17 Aug. 1899, 64: 646[17])

Identifies Galerucella luteola Müll. from East Greenbush N. Y and gives remedies.

Rose pest. (Country gentleman, 17 Aug. 1899, 64: 646[26])

Identifies Homoptera lunata Drury, as the species injuring roses at Great Barrington Mass. and gives several remedies.

[Voluntary entomologic service of New York] (Country gentleman, 17 Aug. 1899, 64: 655[11])

Abstract of reports from voluntary observers.

Worms in mushroom bed. (Country gentleman, 24 Aug. 1899, 64: 666[33])

Identifies the attack at Marshfield Hills Mass. as probably that of a species of Sciara and recommends several remedies.

Lilac caterpillars. (Country gentleman, 24 Aug. 1899, 64: 673[11])

Larvae of Promethea moth, Callosamia promethea Drury (syn. Attacus) are briefly described and Dr Lintner's experiment with one is mentioned.

[Voluntary entomologic service of New York] (Country gentleman, 31 Aug. 1899, 64: 698[16])

Abstract of reports from voluntary observers.

Formulas for insecticides and fungicides. (Folder of state department of agriculture, 1899, p. 1–11)

In addition to matter in an earlier edition, the following is given: general directions for the application of insecticides, for the preparation of paris green, london purple, arsenite of lime, arsenate of lead, poison carriers, and for using carbon bisulfid.

Descriptive catalogue of insects exhibited at New York state fair, Syracuse, 4–9 Sep. 1899, p. 1–28. (Folder University of the State of New York, New York state museum)

Gives briefly the characteristics of over 80 species of insects of economic importance and indicates methods of treatment for injurious forms.

Bark louse. (Country gentleman, 7 Sep. 1899, 64: 706[46])

Scurfy bark louse, Chionaspis furfurus Fitch, on apple is identified and a remedy is given.

[Voluntary entomologic service of New York] (Country gentleman, 7 Sep. 1899, 64: 707[13])

Abstract of reports from voluntary observers.

[Sugar maple borer] (Leroy [N. Y.] gazette, 13 Sep. 1899, p. 1)

Describes the injurious work of Plagionotus speciosus Say in Leroy, mentions the associated borer, Tremex columba Linn., and its parasite, Thalessa lunator Fabr. Several preventive and remedial measures are given.

Notes of the year for New York. (Country gentleman, 14 Sep. 1899, 64: 733[16])

The following insects are noticed: willow butterfly, Euvanessa antiopa Linn.; red-headed flea beetle, Systena frontalis Fabr.; forest tent caterpillar, Clisiocampa disstria Hübn.; elm leaf beetle, Galerucella luteola Müll.; asparagus beetles, Crioceris asparagi Linn. and C. 12-punctata Linn.; and 17 year cicada, Cicada septendecim Linn.

Willow butterfly. (Country gentleman, 21 Sep. 1899, 64: 746[25])

Larvae of Euvanessa antiopa Linn. are identified and described, and the principal features of the adult are given.

Strawberry insects. (Country gentleman, 21 Sep. 1899, 64: 746[35])

Gives remedies for white grubs in a strawberry bed.

[Voluntary entomologic service of New York] (Country gentleman, 21 Sep. 1899, 64: 758[15])

Abstracts of reports from voluntary observers.

Potato scab and insects. (Country gentleman, 28 Sep. 1899, 64: 766[21])

Gives several preventives of potato scab and states that the small irregular holes eaten into the potatoes are probably the work of myriapods, though the offenders may be true wire worms.

Controlling insect pests. (Country gentleman, 28 Sep. 1899, 64: 767[26])

Shows the difficulty of constantly maintaining another's point of view and asserts that the Association of economic entomologists heartily indorses all well directed efforts to suppress or exclude foreign insect pests. Though it may be impossible to prevent the eventual introduction of certain insects protection for a time is valuable.

[Voluntary entomologic service of New York] (Country gentleman, 28 Sep. 1899, 64: 767[44])

Abstracts of reports from voluntary observers.

Student collectors of insects. (Times-Union [Albany] 29 Sep. 1899, p.1; Argus [Albany] 30 Sep. 1899, p.5)

Circular letter offering pupils in regents high schools a nominal price for insects.

Katydid eggs. (Country gentleman, 5 Oct. 1899, 64: 786[24])

The eggs of Microcentrum retinervis Burm. are identified and oviposition is described.

White-lined sphinx. (Country gentleman, 5 Oct. 1899, 64: 792[43])

Deilephila lineata Fabr. is identified from a brief description and the moth and larva are described.

CONTRIBUTIONS TO THE COLLECTION 15 OCT. 1898 — 14 OCT. 1899

Hymenoptera

Bumble bees, Bombus fervidus Fabr. and Bombus virginicus Oliv.; honey bee, Apis mellifica Linn. and large carpenter bee, Xylocopa virginica Drury, 21 June; from **W. C. Hitchcock,** Cropseyville N. Y.

Carpenter bee as above, 23 June and wasp, Polistes pallipes St. Farg. 17th Aug.; from Mrs **E. B. Smith,** Coeymans N. Y.

Sphex ichneumonea Linn. 31 July; from **James A. Burns,** Albany N. Y.

Pelopoeus caementarius Drury, 17 Aug.; from Mrs **E. B. Smith,** Coeymans N. Y.

Red ant, Monomorium pharaonis Linn. 1 Sep.; from **G. H. Anderson,** Albany N. Y.

Pelecinus polyturator Drury, 2 Aug.; from **Arthur Carty,** Albany N. Y.

Pupae of Cratotechus species, 6 July; from **Rhoda Thompson,** Ballston Spa N. Y.

Dibrachys boucheanus Ratz., from cocoons of Clisiocampa disstria Hübn., 5 July; from **C. L. Williams,** Glens Falls N. Y.

Pimpla conquisitor Say, from cocoons of Clisiocampa disstria, 5 July; from **C. L. Williams,** Glens Falls N. Y.

Lunate long-sting, Thalessa lunator Fabr. 21 June; from **W. C. Hitchcock,** Cropseyville N. Y. Same, 24 July; from **C. J. Tobin,** Albany N. Y. Same, 8 Aug.; from **H. F. Cleveland,** Leroy N. Y.

Exochilum mundum Say, 17 Aug.; from Mrs **E. B. Smith,** Coeymans N. Y.

Ophion tityri Pack. 21 June; from **W. C. Hitchcock,** Cropseyville N. Y.

Ichneumon seminiger Cress. 14 Ap.; from **Franklin Sherman jr,** Foresthome, Tompkins co. N. Y.

Galls of Holcaspis globulus Fitch on bur oak, 28 Sep.; from **L. E. Boutwell,** Eden N. Y.

Pigeon Tremex, Tremex columba Linn. 5 July; from **F. J. Riggs,** Albany N. Y. Same, 15 specimens, 21 July; from **Alfred Scoons,** Albany N. Y. Same, 3 Aug.; from **A. P. Williams,** Mannsville N. Y.

Urocerus albicornis Fabr. 12 July; from **F. J. Riggs,** Albany N. Y.

Currant borers Janus integer Norton, 7 and 19 Ap.; from **Thomas Tupper,** Corning N. Y.

Monostegia rosae Harris on rose, 15 June; from **W. R. Houston,** Geneseo N. Y.

Larvae of Monophadnoides rubi Harr. on raspberry, 10 June; from **C. H. Stuart,** Newark N. Y.

Dolerus arvensis Say, injuring apple leaves, 3 May; from **Paul Roach,** Quaker Street, Schenectady co. N. Y.

Larvae and pupae of Pteronus ribesii Scop. on leaves of currant, 19 May; from Miss **E. P. Dennison,** Binghamton N. Y. Same, 1 June; from **Rhoda Thompson,** Ballston Spa N. Y.

Lygaeonematus erichsonii Hart. on European larch, 13 June; from **Cyrus Crosby,** Crosby N. Y. Same, 20 June; from Mrs **L. A. Millington,** New Russia N. Y.

Coleoptera

Grain weevil, Calandra granaria Linn. overrunning a house, 2 June; from **Cyrus Crosby,** Crosby N. Y.

Chestnut weevil, Balaninus species, 10 larvae in one chestnut, 31 Oct.; from **J. A. Otterson,** Berlin Mass.

Ovate snout beetle, Otiorhynchus ovatus Linn. 6 July; from **C. C. Merriam,** Lyon Falls N. Y.

Ash gray blister beetle, Epicauta cinerea Forst. on Clematis paniculata, 7 Aug.; from **W. T. Cox,** Millneck, Nassau co. N. Y.

Striped blister beetle, Epicauta vittata Fabr. on potato vines, 2 Aug; from **James Bacon,** Jericho N. Y.

Forked fungus beetle, Boletotherus bifurcus Fabr. 3 Ap; from **C. S. Watrous,** Walton N. Y.

Meal worm, Tenebrio molitor Linn. 22 May; from **C. H. Stuart,** Newark N. Y. Same, 23 June; from Mrs **E. B. Smith,** Coeymans N. Y.

Haplandrus femoratus Fabr. 23 June; from Mrs **E. B. Smith,** Coeymans N. Y.

Bean weevil, Bruchus obtectus Say 31 Oct.; from **M. M. Miller,** Evans Mills, Jefferson co. N. Y. through the state department of agriculture.

Argus tortoise beetle, Chelymorpha argus Licht. on sugar beets in Onondaga co. 31 Aug.; from **G. G. Atwood,** Geneva N. Y.

Clubbed tortoise beetle, Coptocycla clavata Fabr. 23 June; from Mrs **E. B. Smith,** Coeymans N. Y.

Red-headed flea beetle, Systena frontalis Fabr. injuring sugar beets at Syracuse, 3 Aug.; from **G. G. Atwood,** Geneva N. Y.

Cucumber flea beetle, Epitrix cucumeris Harr. on tomatoes and potatoes, 6 June; from **C. B. Cook,** Oswego Center N. Y.

Grape vine flea beetles, Haltica chalybea Ill. under bark of elm, 8 Nov.; from **M. Goldman,** Pittsfield Mass. Larvae of same on grape, 24 May; from **F. A. Taber,** Poughkeepsie N. Y. Same, 6 June; from **C. H. Stuart,** Newark N. Y.

Larvae of Disonycha ?triangularis Say, skeletonizing elm leaves, 14 July; from **G. S. Graves,** Newport N. Y.

Elm leaf beetle, Galerucella luteola Müll. adults and pupae, 26 July; from **Alice Young,** Clinton Mass. Same, 28 July; from **J. A. Otterson,** Berlin Mass. Same, 11 Aug.; from **N. Davenport,** East Greenbush N. Y.

Chrysomela multiguttata Stäl. 11 May; from Mrs **Glode Young,** Clinton Mass.

Striped cucumber beetle, Diabrotica vittata Fabr. 15 June; from **Rhoda Thompson,** Ballston Spa N. Y. Same, 26 Aug.; from **Harry W. Riggs,** Albany N. Y.

12 spotted asparagus beetle, Crioceris 12-punctata Linn. 22 May and 6 June; from **C. H. Stuart,** Newark N. Y. Same, 29 May; from **J. U. Metz,** East Amherst N. Y. Same, 17 July; from

C. H. Peck, Menands N. Y. Same with larvae, 16 Sep.; from **W. H. McLaughlin,** Oswego Center N. Y. Same from Ithaca N. Y. 22 Sep.; from **Cyrus Crosby,** Crosby N. Y.

Asparagus beetle, Crioceris asparagi Linn. 22 May and 6 June; from **C. H. Stuart,** Newark N. Y. Same, 21 May; from **J. U. Metz,** East Amherst N. Y. Same, 1 June; from **W. R. Houston,** Geneseo N. Y. Same on asparagus, 5 June; from **C. H. Peck,** Menands N. Y. Same, 7 June; from **C. L. Allen,** Floral Park N. Y. Same, 20 June; from **O. Q. Flint,** Athens N. Y. Same with larvae, 16 Sep.; from **W. H. McLaughlin,** Oswego Center N. Y. Same, 18 Sep.; from **Jack Landers,** Whitesboro N. Y.

Raspberry cane girdler, Oberea bimaculata Oliv. girdling blackberry canes, 21 June; from **Lewis Hooker,** Rochester N. Y. Raspberry cane showing oviposition of same, 21 July; from **Mary B. Sherman,** Ogdensburg N. Y.

Larvae of Saperda calcarata Say, from Populus monilifera, 16 Aug.; from **M. F. Adams,** Buffalo N. Y.

Hyperplatys maculatus Hald. 17 Aug.; from Mrs **E. B. Smith,** Coeymans N. Y.

Leptura canadensis Fabr., male, 7 Aug.; from **Mary B. Sherman,** Ogdensburg N. Y.

Cloaked knotty horn, Desmocerus palliatus Forst. 30 June; from **Amos Carty,** Albany N. Y.

Neoclytus erythrocephalus Fabr. 22 May; from **C. H. Stuart,** Newark N. Y.

Sugar maple borer, Plagionotus speciosus Say, 14 June; from **O. Q. Flint,** Athens N. Y. Larvae of same, 11 Aug. and 5 Oct. and sections of sugar maple showing work of same, 1 Sep.; all from **M. F. Adams,** Buffalo N. Y.

Locust borer, Cyllene robiniae Forst. 4 Sep.; from **M. F. Adams,** Buffalo N. Y. Same on locust, 20 Sep.; from **J. E. West,** Poughkeepsie N. Y.

Hickory twig containing maple pruner, Elaphidion villosum Fabr. 2 Nov.; from **Dr S. A. Russell,** Poughkeepsie N. Y. Same, 21 June; from **W. C. Hitchcock,** Cropseyville N. Y.

Orthosoma brunneum Forst. 26 July; from **Jesse Barnet,** Roundlake N. Y. Same, 27 July; from **J. B. Briggs,** Macedon N. Y. Same 8 Aug.; from **J. F. Rose,** South Byron N. Y. Same, 8 Aug.; from **C. E. Childs,** Mayfield N. Y. Same, 12 Sep; from Miss **A. M. Armstrong,** Belle Isle N. Y.

Rough flower beetle, Osmoderma scabra Beauv., 23 June; from Mrs **E. B. Smith,** Coeymans N. Y. Same, 12 July; from **F. J. Riggs,** Albany N. Y. Same, 28 July; from **Rhoda Thompson,** Ballston Spa N. Y. Same, 29 July; from **J. A. Otterson,** Berlin Mass. Same, 12 Sep.; from Miss **A. M. Armstrong,** Belle Isle N. Y.

Bumble flower beetle, Euphoria inda Linn. 23 May and 21 June; from **W. C. Hitchcock,** Cropseyville N. Y. Same, 30 Sep.; from **D. H. Burrell jr,** Littlefalls N. Y.

Goldsmith beetle, Cotalpa lanigera Linn. 29 July; from **J. A. Otterson,** Berlin Mass.

Spotted grape vine beetle, Pelidnota punctata Linn. 8 July; from **Lillian Flanders,** Albany N. Y. Same, 14 July; from Mrs **B. Gehring,** Albany N. Y. Same, 2 specimens, 19 July; from **John De Groot** and **Edith Phelps,** Albany N. Y. Same, 28 July; from **Rhoda Thompson,** Ballston Spa N. Y. Same, 8 Aug.; from **G. S. Graves,** Newport N. Y. Same, 12 Sep.; from Miss **A. M. Armstrong,** Belle Isle, N. Y.

Light-loving grape vine beetle, Anomala lucicola Fabr. 6 July; from **Rhoda Thompson,** Ballston Spa N. Y.

Polyphylla variolosa Hentz. 28 July; from **George Van V. Warner,** Asbury Park N. J.

Larva of May beetle, Lachnosterna ?fusca Fröhl., infested by Cordyceps ravenelii, 21 Ap.; from **C. E. Childs,** Mayfield N. Y. Larvae of same, 23 May; from **Dr J. B. Washburne,** Delmar N. Y. Same, 1 June; from **Rhoda Thompson,** Ballston Spa N. Y. Same, injuring strawberries, 6 July; from **Mary B. Sherman,** Ogdensburg N. Y.

Rose beetle, Macrodactylus subspinosus Fabr. 22 May; from **C. H. Stuart,** Newark N. Y. Same, 15 June; from **Rhoda Thompson,** Ballston Spa N. Y. Same, injuring hydrangeas and roses, 18 June; from **G. S. Graves,** Newport N. Y. Pupae of same, 23 May; from **Dr J. B. Washburne,** Delmar N. Y.

Hoplia trifasciata Say, on Kieffer pear flowers, 12 May; from **H. C. Peck,** Brighton N. Y.

Stag beetle, Lucanus dama Thunb. 28 July; from **Rhoda Thompson,** Ballston Spa N. Y.

Powder post beetle, Lyctus unipunctatus Hbst., from boards in carriage, 15 June; from Mrs **James Holroyd,** Albany N. Y.

Larva of cigarette beetle, Lasioderma serricorne Fabr. in goldfish food, 23 Nov.; from Mrs **E. C. Anthony,** Gouverneur N. Y.

Telephorus carolinus Fabr. 21 June; from **W. C. Hitchcock,** Cropseyville N. Y.

Larvae of bronze birch borer, Agrilus anxius Gory, infesting birch at Buffalo N. Y. 18 Nov; from **J. C.** ———. ? Same on birch, 8 Ap. and pupae of same, 5 May; from **M. F. Adams,** Buffalo N. Y.

Melanophila ?drummondi Kirby, 21 June; from **W. C. Hitchcock,** Cropseyville N. Y.

Divaricated Buprestid, Dicerca divaricata Say, 27 July; from **O. Q. Flint,** Athens N. Y. Same 8 Aug.; from **G. S. Graves,** Newport N. Y. Same 29 Aug.; from Mrs **E. B. Smith,** Coeymans N. Y.

Chalcophora liberta Germ. 21 June; from **W. C. Hitchcock,** Cropseyville N. Y.

Owl beetle, Alaus oculatus Linn. 1 July; from **J. U. Metz,** East Amherst N. Y. Same, 17 July; from **C. E. Chapman,** Peruville N. Y. Same, 21 June; from **W. C. Hitchcock,** Cropseyville N. Y.

Cadelle, Tenebriodes mauritanica Linn. larva, 26 Aug.; from Mrs **F. J. Riggs,** Albany N. Y.

Ips quadriguttatus Fabr. 30 Sep. from **D. H. Burrell jr,** Littlefalls N. Y.

Buffalo carpet beetle, Anthrenus scrophulariae Linn. and Anthrenus verbasci Linn. 20 Feb. from **Prof. Charles H. Peck,** Menands N. Y.

Whalebone cane eaten by larvae of black carpet beetle, Attagenus piceus Oliv. found among the effects of the late Dr Hall, 13 Dec. from **J. M. Clarke,** Albany N. Y. Adult of same, 17 Aug. from Mrs **E. B. Smith,** Coeymans N. Y.

Bacon beetle, Dermestes lardarius Linn. in meat box, 15 June; from **W. R. Houston,** Geneseo N. Y. Same working in pine floor of house, 1 July; from **J. U. Metz,** East Amherst N. Y.

Saw-toothed grain beetle, Silvanus surinamensis Linn. 2 Aug.; from **L. H. Hurd,** Albany N. Y. Same, 26 Aug.; from Mrs **F. J. Riggs,** Albany N. Y.

Pentilia misella Lec. among plant lice on elm leaves, 2 June; from **Cyrus Crosby,** Crosby N. Y.

Two spotted lady bug, Adalia bipunctata Linn. larvae and pupae, 3 and 6 June; from **J. Jay Barden,** Stanley N. Y. 35 specimens of same, 14 Oct.; from **F. E. Dawley,** Fayetteville N. Y.

Carrion beetle, Silpha americana Linn. 3 Ap.; from **C. S. Watrous,** Walton N. Y. Same, 23 May; from **W. C. Hitchcock,** Cropseyville, N. Y.

Harpalus caliginosus Fabr. 23 May; from **Dr J. B. Washburne,** Delmar N. Y. Same, 26 Aug.; from **F. J. Riggs,** Albany N. Y.

Harpalus pennsylvanicus DeGeer, 17 Aug. from Mrs **E. B. Smith,** Coeymans N. Y.

Agonoderus pallipes Fabr. 21 June; from **W. C. Hitchcock,** Cropseyville N. Y.

Platynus cupripennis Say, 14 Ap.; from **Franklin Sherman jr.** Foresthome, Tompkins co. N. Y.

Calosoma scrutator Fabr. 13 June; from **Herman Sellnow,** Albany N. Y.

Purple tiger beetle, Cicindela purpurea Oliv. 3 Ap.; from **C. S. Watrous,** Walton N. Y.

Six spotted tiger beetle, Cicindela 6-guttata Fabr. 22 May; from **Alice Young,** Clinton Mass. Same, 3 Ap.; from **C. S. Watrous,** Walton N. Y.

Diptera

Sheep tick Melophagus ovinus Linn. from sheep, 25 May; from **Rhoda Thompson,** Ballston Spa N. Y.

Bot fly, Gastrophilus equi Fabr. female, 21 June; from **W. C. Hitchcock,** Cropseyville N. Y.

Pupae of ? Eristalis tenax Linn. from **O. Q. Flint,** Athens N. Y.

Large black horse fly, Tabanus atratus Fabr. 21 July; from **Albert Kelly** and **Frank Riordan,** Albany N. Y. Same 26 Aug.; from **F. J. Riggs,** Albany N. Y.

Chrysops niger Macq. 23 May; from **W. C. Hitchcock,** Cropseyville N. Y. Same 23 June; from Mrs **E. B. Smith,** Coeymans N. Y.

Pupae of Sciara species in moss, 23 Nov. from Mrs **E. C. Anthony,** Gouverneur N. Y.

Wheat midge, Diplosis tritici Kirby, infesting wheat, 20 June; from Miss **A. M. Armstrong,** Belle Isle N. Y.

Wheat stems infested with Hessian fly, Cecidomyia destructor Say, 18 June and 1 July; from **J. U. Metz,** East Amherst N. Y. Same

20 June; from Miss **A. M. Armstrong,** Belle Isle N. Y. Same in wheat from Illinois, 20 Oct.; from **C. W. Stuart & Co.,** Newark N. Y.

Willow twigs infested with Cecidomyia species, 15, 18, 22 Mar.; from **H. C. Peck,** Brighton N. Y.

Lepidoptera

Chrysalis of milkweed butterfly, Anosia plexippus Linn. 19 July; from **T. B. Basselin,** Croghan N. Y. Adults of same, as follows: 24 July; from Mrs **G. L. Flanders,** Albany N. Y. 5 Aug.; from **Helen Monahan,** Albany N. Y. (8 specimens) 5 Aug.; from **Amos Carty,** Albany N. Y. 17 Aug. from Mrs **E. B. Smith,** Coeymans N. Y. 28 Aug.; from **E. J. Preston,** Amenia N. Y. Discolored chrysalis of same, 26 Sep. from **C. H. Stuart,** Newark N. Y.

Red spotted purple, Basilarchia astyanax Fabr. 27 July; from **Marguerite Riggs,** Albany N. Y.

Viceroy, Basilarchia archippus Cram. 4 specimens, 21 June; from **W. C. Hitchcock,** Cropseyville N. Y.

Larva of violet tip, Polygonia interrogationis Fabr. on currant, 31 May; from **G. S. Graves,** Newport N. Y. Same, 15 June; from **Rhoda Thompson,** Ballston Spa N. Y. Same and work on hop leaves, 12 Aug.; from **W. B. Dupree,** Centerport N. Y.

Willow butterfly, Euvanessa antiopa Linn. larvae on maples, 5 June; from **A. P. Finder,** Troy N. Y. Same on elm, 7 June; from **G. M. Ingalsbe,** Sandyhill N. Y. Same, 9 June; from **S. L. Frey,** Palatine Bridge N. Y. Same on elm, 9 June; from Mrs **Glode Young,** Clinton Mass. Same on elm, 9 June; from **E. T. Schoonmaker,** Albany N. Y. Same, 12 June; from **J. H. Durkee,** Sandyhill N. Y. Same, 15 June; from **Rhoda Thompson,** Ballston Spa N. Y. Same 21 June; from **W. C. Hitchcock,** Cropseyville N. Y. Same, 29 June; from **H. S. Ambler,** Chatham N. Y.

Great spangled fritillary, Argynnis cybele Fabr. three specimens; meadow fritillary, Brenthis bellona Fabr.; pearl crescent, Phyciodes tharos Drury; American copper, Heodes hypophleas Boisd.; and clouded sulfur, Eurymus philodice Godt. male and female, 21 June; from **W. C. Hitchcock,** Cropseyville N. Y.

Cabbage butterfly, Pieris rapae Linn. 12 Sep.; from Miss **A. M. Armstrong,** Belle Isle N. Y.

Pupa of the blue swallow-tail, Laertias philenor Linn. from larva on Dutchman's pipe, 8 Aug.; from **Charles Lyman,** Bellport N. Y.

Black swallow-tail, P a p i l i o p o l y x e n e s Fabr., 2 specimens, 21 June; from **W. C. Hitchcock,** Cropseyville N. Y. Larva of same, 22 June; from **Cyrus Crosby,** Crosby N. Y. Same, 6 July; from **Rhoda Thompson,** Ballston Spa N. Y. Tiger swallow-tail, J a s o n i a d e s g l a u c u s Linn., four specimens, 21 June; from **W. C. Hitchcock,** Cropseyville N. Y.

Larva of T h y r e u s a b b o t i i Swains. 5 July; from **Harold S. Downer,** Albany N. Y. Same, 5 July; from **O. Q. Flint,** Athens N. Y. Same 15 July; from **M. Goldman,** Pittsfield Mass. Same, 17 Aug.; from Mrs **L. A. Millington,** New Russia N. Y.

Tomato worm, P h l e g e t h o n t i u s c e l e u s Hübn. 3 Aug.; from **H. U. Swinnerton,** Cherry Valley N. Y. Same, 3 Aug.; from **J. H. Farrell,** Albany N. Y. Same, 20 Oct.; from Mrs **E. B. Smith,** Coeymans N. Y.

White-lined sphinx, D e i l e p h i l a l i n e a t a Fabr. 12 Aug.; from **John Jackson,** Albany N. Y. Same, 17 Aug.; from Mrs **E. B. Smith,** Coeymans N. Y. Same, 26 Aug.; from **F. J. Riggs,** Albany N. Y. Same, 28 Aug.; from **V. P. D. Lee,** Altamont N. Y. Same, August; from **O. Q. Flint,** Athens N. Y. Same, 11 Oct.; from **B. Walton Smith,** captured near Paul Smiths in the Adirondacks, about 20 Sep. 1879.

P h i l a m p e l u s p a n d o r u s Hübn. 11 July; from **Dr J. B. Washburne,** Delmar N. Y. Same, 5 Aug.; from **Catherine Fivey,** Albany N. Y. Larva of same, 28 Aug. from **C. E. Childs,** Mayfield N. Y Same, 31 Aug.; from Miss **F. L. Briggs,** Coeymans N. Y.

Grape vine hog-caterpillar, A m p e l o p h a g a m y r o n Cram. parasitized by A p a n t e l e s c o n g r e g a t u s Say, 20 July; from **H. M. Pollock,** Patria N. Y.

Painted footman, H y p o p r e p i a f u c o s a Hübn. and H a p l o a c o n f u s a Lyman; from **Addison Ellsworth,** Binghamton N. Y.

Harlequin caterpillar, E u c h a e t e s e g l e Drury, 27 Aug.; from Mrs **E. B. Smith,** Coeymans N. Y.

Hickory tussock moth, H a l i s i d o t a c a r y a e Harr. 21 June; from **W. C. Hitchcock,** Cropseyville N. Y. Larva of same 28 July; from **J. A. Otterson,** Berlin Mass. Larva of same 29 Aug.; from Mrs **E. B. Smith,** Coeymans N. Y.

H a l i s i d o t a t e s s e l l a r i s Abb. and Sm. 19 May; from **Addison Ellsworth,** Binghamton N. Y.

Adult female and eggs of E s t i g m e n e a c r a e a Drury, 9 June; from **S. L. Frey,** Palatine Bridge N. Y.

Fall web worm, Hyphantria cunea Drury, larvae on apple, 30 June; from Miss **F. L. Briggs,** Coeymans N. Y. Same, 1 July; from **O. Q. Flint,** Athens N. Y.

Larvae of Isabella tiger moth, Pyrrharctia isabella Abb. and Sm. 20 Oct.; from Mrs **E. B. Smith,** Coeymans N. Y.

Spilosoma virginica Fabr. 17 Aug.; from Mrs **E. B. Smith,** Coeymans N. Y. Same, 12 Sep.; from Miss **A. M. Armstrong,** Belle Isle N. Y.

Euprepia parthenice Kirby and Euprepia arge Drury; from **Addison Ellsworth,** Binghamton N. Y.

Eight spotted forester, Alypia octomaculata Fabr. 9 June; from **F. J. Riggs,** Albany N. Y. Larva of same on grape vine, 17 June; from **J. Jay Barden,** Stanley N. Y.

Brown tail moth, Euproctis chrysorrhoea Linn. in its various stages; from **A. H. Kirkland,** Malden Mass.

Female and eggs of Notolophus antiqua Linn. 28 Sep.; from Mrs **E. C. Anthony,** Gouverneur N. Y.

Eggs of white-marked tussock moth, Notolophus leucostigma Abb. and Sm. 5 Dec.; from **Dr J. B. Washburne,** Delmar N. Y. Same on apple and plum, 3 Feb.; from Geneva N. Y. through state department of agriculture.

Saddle back caterpillar, Sibine stimulea Clem.; 15 Aug. from **O. Q. Flint,** Athens N. Y. Same on sweet peas, 22 Sep.; from Mrs **W. T. Cox,** Millneck N. Y.

Nadata gibbosa Abb. and Sm. from **Addison Ellsworth,** Binghamton N. Y.

Larvae of Symmerista albifrons Abb. and Sm. on white oak, 12 and 17 Aug.; from **W. B. Dupree,** Centerport N. Y.

Yellow-necked apple tree caterpillar, Datana ministra Drury, on quince, 26 Aug.; from **C. H. Peck,** Menands N. Y. Same, 29 Aug.; from **G. S. Graves,** Newport N. Y.

Red-humped apple tree caterpillar, Schizura concinna Abb. and Sm. on apple, 1 July; from **S. B. Huested,** Blauvelt N. Y.

Larva of Schizura unicornis Abb. and Sm. on prune, 29 Aug.; from **Joseph Foord & Sons,** Auburn N. Y.

Bag worm, Thyridopteryx ephemeraeformis Haw. on oak, 9 Aug.; from **Florence W. Myers,** Mt Vernon N. Y.

Cecropia moth, Samia cecropia Linn. two specimens, 21 June; from **W. C. Hitchcock,** Cropseyville N. Y. Same, 5 July; from **George Gamble,** Albany N. Y. Larvae of same, 15 July; from

Rhoda Thompson, Ballston Spa N. Y. Larva of same, 9 Aug.; from **William Osborn,** Albany N. Y.

Larvae of Promethea moth, Callosamia promethea Drury, on lilac, 8 Aug.; from **W. H. Coleman,** Albany N. Y.

Luna moth, Tropaea luna Linn. 30 June; from Miss **McCulloch,** New Scotland N. Y.

Polyphemus moth, Telea polyphemus Cram. 30 June; from **Theresa E. Johnson,** Streetroad N. Y. Same, 11 July; from Mrs **Hurley,** Albany N. Y. Larva of same on oak, 16 Aug.; from **Mary B. Sherman,** Ogdensburg N. Y. Same, 12 Sep. from Miss **A. M. Armstrong,** Belle Isle N. Y.

Io moth, Automeris io Fabr. 15 June; from **Rhoda Thompson,** Ballston Spa N. Y. Larva of same on corn, 28 Aug.; from **Charles E. Childs,** Mayfield N. Y. Larva of same, 29 Aug.; from Mrs **E. B. Smith,** Coeymans N. Y.

Larvae of Anisota senatoria Abb. and Sm. on oak, 17 Aug.; from **W. B Dupree,** Centerport N. Y.

Imperial moth, Basilona imperialis Drury with eggs, 30 June; from **Rhoda Thompson,** Ballston Spa N. Y. Same, 18 July; from **George Gamble,** Albany N. Y. Same, 19 July; from **Gustav Sickinger,** Albany N. Y. Larva of same, 27 Aug. from **Eunice S. Lamson,** Mannsville N. Y.

Egg belts of forest tent caterpillar, Clisiocampa disstria Hübn. abundant in orchards, 3 Feb.; from Geneva N. Y. through state department of agriculture. Same on maple, 18 Mar.; from **J. Thomson,** Rochester N. Y. Same, 24 Mar. from **C. H. Darrow,** Geneva N. Y. Larvae of same on apple, 10 May; from **G. A. Flashover,** Colonie N. Y. On cherry, 12 May; from Mrs **E. B. Smith,** Coeymans N. Y. 11 May; from **C. H. Peck,** Menands N. Y. On pear, 24 May; from **C. H. Peck,** Menands N. Y. 29 May; from Mrs **E. L. Strong,** Ogdensburg N. Y. 1 June; from **C. C. Merriam,** Lyon Falls N. Y. Same, 1 June; from **J. H. Durkee,** Sandyhill N. Y. On maple, 5 June; from **A. P. Finder,** Troy N. Y. 6 June; from **G. T. Powell,** Ghent N. Y. 6 June; from **James Hendricks,** Slingerlands N. Y. 20 June; from **Mary B. Sherman,** Ogdensburg N. Y. Same and pupae, 26 June; from **C. C. Merriam,** Lyon Falls N. Y. Cocoons of same in various leaves, 1 July; from **G. S. Graves,** Newport N. Y. and 6 July; from **Rhoda Thompson,** Ballston Spa N. Y. Eggs of same on apple, 28 July; from **Mary B. Sherman,** Ogdens-

burg N. Y. Numerous egg belts of same, 29 Aug. from **G. S. Graves,** Newport N. Y.

Apple tree tent caterpillar, Clisiocampa americana Fabr. eggs on apple, 3 Mar.; from **J. Jay Barden,** Stanley N. Y. Same 6 Mar.; from **J. Thompson,** Cobleskill N. Y. Larvae of same, 22 May; from Miss **A. M. Armstrong,** Belle Isle N. Y. Same, 1 June; from **C. C. Merriam,** Lyon Falls N. Y. Same, 1 June; from **J. H. Durkee,** Sandyhill N. Y. Egg belts of same 29 Aug.; from **G. S. Graves,** Newport N. Y.

Larva of lappet moth, Tolype velleda Stoll, from Burlington Vt. 8 July; from **P. K. Nott,** Troy N. Y. Same, 27 July; from **Richard DeGroot,** Albany N. Y.

Arsilonche albovenosa Goeze., Acronycta oblinita Abb. and Sm., Acronycta dactylina Grt., Microcoelia diphteroides Guen.; from **Addison Ellsworth,** Binghamton N. Y.

Variegated cut worms, Peridroma saucia Hübn. attacking carnations, 28 Ap.; from **Charles Limmer,** Cobleskill N. Y.

Noctua c-nigrum Linn. and Feltia subgothica Haw. from **Addison Ellsworth,** Binghamton N. Y.

Striped cut worm, Carneades tessellata Harr. attacking cabbage, 12 Sep.; from **C. L. Allen,** Floral Park N. Y.

Dark-sided cut worm, Carneades messoria Harr. 23 May; from **Dr J. B. Washburne,** Delmar N. Y.

Zebra caterpillar, Mamestra picta Harr. on strawberry, 6 June; from **G. T. Powell,** Ghent N. Y.

Mamestra cristifera Walk., M. renigera Steph., M. purpurissata Grt., M. subjuncta Gr. and Rob., Xylophasia devastatrix Brace; from **Addison Ellsworth,** Binghamton N. Y. X. devastatrix Brace, 12 Sep.; from Miss **A. M. Armstrong,** Belle Isle N. Y. X. arctica Boisd. 7 July; from **O. Q. Flint,** Athens N. Y. Same, 28 July; from **Rhoda Thompson,** Ballston Spa N. Y.

Dipterygia scabriuscula Linn., Brotolomia iris Guen., Hydroecia velata Walk. 19 May; from **Addison Ellsworth,** Binghamton N. Y.

Hydroecia nitela Guen. larva in potato stalk, 6 June; from **Thomas Tupper,** Corning N. Y. Same, 13 July; from **C. L. Williams,** Glens Falls N. Y.

Leucania multilinea Walk. 21 June; from **W. C. Hitchcock,** Cropseyville N. Y. Same, male and female, Amphipyra pyra-

midoides, Guen., Scopelosoma graefiana Grt., Cucullia asteroides Guen., Plusia simplex Guen.; from **Addison Ellsworth,** Binghamton N. Y.

Plusia precationis Guen., 8 July; from **Marguerite Riggs,** Albany N. Y.

Chamyris cerintha Treits; from **Addison Ellsworth,** Binghamton N. Y.

Catacola unijuga Walk. 18 July; from **George Gamble,** Albany N. Y.

Larva of Homoptera lunata Drury, injuring rosebuds, 8 Aug.; from Great Barrington Mass. through *Country gentleman.*

Eggs of fall canker worm, Alsophila pometaria Harr. on maple probably, 15 Mar.; from **J. Thomson,** Rochester N. Y.

Haematopis grataria Fabr. from **Addison Ellsworth,** Binghamton N. Y. Same, male and female, and Synchlora glaucaria Guen. 21 June; from **W. C. Hitchcock.** Cropseyville N. Y.

Currant span worm Diastictis ribearia Fitch on currant, 7 June; from **Mary B. Sherman,** Ogdensburg N. Y.

Lycia cognataria Guen., Rhaphidodemas titea Cram.; from **Addison Ellsworth,** Binghamton N. Y.

Lime tree winter moth, Erannis tiliaria Harr. 28 Oct; from Mrs **E. C. Anthony,** Gouverneur N. Y. Larvae of same, 1 June; from **C. C. Merriam,** Lyon Falls N. Y.

Cingilia catenaria Cram.; from **G. S. Graves,** Newport N. Y.

Xanthotype crocataria Fabr., Euchlaena serrata Drury, Endropia bilinearia Pack., Azelina peplaria Hübn.; from **Addison Ellsworth,** Binghamton N. Y. Pyrausta futilalis Led. from dogbane, 24 May; from **Cyrus R. Crosby,** Crosby N. Y.

Clydonopteron tecomae Riley, reared from pods of Tecoma radicans, 24 Jan.; from **F. C. Pratt,** Washington D. C.

Work of leaf crumpler, Mineola indigenella Zell. from Michigan, 21 June; from **J. F. Rose,** South Byron N. Y.

Larvae of gartered plume moth, Oxyptilus periscelidactylus Fitch on grape, 5 June; from **C. H. Peck,** Menands N. Y. Same, 1 June; from **Rhoda Thompson,** Ballston Spa N. Y.

Larvae of cherry Tortrix, Cacoecia cerasivorana Fitch, 19 June; from **Jeanette C. Miller,** Aldercreek N. Y.

Hibernacula and larvae of bud moth, Tmetocera ocellana Schiff. 11 May; from **M. V. Slingerland**, Ithaca N. Y.

Larvae of codling moth, Carpocapsa pomonella Linn. 5 Dec.; from **Dr J. B. Washburne,** Delmar N. Y.

Pistol case bearer, Coleophora malivorella Riley, 3 Feb.; from Geneva N. Y. through state department of agriculture. Same on apple, 3 Mar.; from **J. Jay Barden,** Stanley N. Y.

Maple leaves mined by Lithocolletis aceriella Clem. 10 Sep.; from **Jeanette C. Miller,** Aldercreek N. Y.

Leaves of chestnut oak mined by Lithocolletis hamadryadella Clem. 20 July; from **C. Cruger,** Cruger's Island N. Y.

Larvae of apple leaf miner, Tischeria malifoliella Clem. 2 Nov.; from Forestlawn, Monroe co. N. Y. through state department of agriculture.

Apple tree Bucculatrix, Bucculatrix pomifoliella Clem. 3 Feb.; from Geneva N. Y, through state department of agriculture.

Hibernacula of Micropteryx pomivorella Pack. on apple 15, 18, 22 Mar.; from **H. C. Peck,** Brighton N. Y. Hundreds of hibernacula of same on apple twigs, 25, 31 Mar. from **G. G. Atwood,** Geneva N. Y.

Neuroptera

Horned Corydalis, Corydalis cornuta Linn. 17 July; from Mrs **M. B. Witherell,** Shushan N. Y. Same, 20 July; from **Mary B. Sherman,** Ogdensburg N. Y. Same, 19 Aug.; from **W. J. Woodman,** Albany N. Y.

Polystoechotes punctatus Fabr. 26 July; from **Jesse Barnet,** Troy N. Y. Same, 2 Sep.; from **G. S. Graves,** Newport N. Y.

Hemiptera

Sehirus bicolor Linn., Pentatoma (Tropicoris) rufipes Linn., Carpocoris (Pentatoma) fuscispinus Boh. from **G. W. Kirkaldy,** Wimbledon Eng.

Eggs and young of spined soldier bug, Podisus spinosus Dallas, on raspberry, 15 Aug.; from Mrs **H. E. Robinson,** North Nassau N. Y. Same preying on potato beetles, 2 Aug.; from **J. H. Clark,** Moreton Farms N. Y. Same, 17 Aug.; from Mrs **E. B. Smith,** Coeymans N. Y.

Cosmopepla carnifex Fabr., Nezara hilaris Say, 29 Aug.; from Mrs **E. B. Smith,** Coeymans N. Y.

Acanthosoma haemorrhoidale Linn. from **G. W. Kirkaldy,** Wimbledon Eng.

Eggs and young of squash bug, Anasa tristis DeGeer, 31 July; from **H. N. Howe,** Ontario. Same on squash, 17 Aug.; from **W. B. Dupree,** Centerport N. Y. Same, 26 Aug.; from **Harry W. Riggs,** Albany N. Y.

Chinch bug, Blissus leucopterus Say, 14 Ap.; from **Franklin Sherman jr,** Foresthome, Tompkins co. N. Y.

Anthocoris nemoralis Fabr., Anthocoris sylvestris Linn., Miris calcaratus Fall from **G. W. Kirkaldy,** Wimbledon Eng.

Leptoterna dolobrata Linn. abundant in grass, 2 June; from **Cyrus Crosby,** Crosby N. Y.

Calocoris 6-guttatus Fabr. from **G. W. Kirkaldy,** Wimbledon Eng.

Tarnished plant bug, Lygus pratensis Linn. injuring Japanese plums and quinces, 3 May; from **Paul Roach,** Quaker Street, Schenectady co. N. Y. Same abundant on grape, 2 June; from **Cyrus Crosby,** Crosby N. Y.

Four lined leaf bug, Poecilocapsus lineatus Fabr. injuring potatoes, 17 June; from **J. Jay Barden,** Stanley N. Y. Same, 23 June; from Mrs **E. B. Smith,** Coeymans N. Y. Same, 12 Sep.; from Miss **A. M. Armstrong,** Belle Isle N. Y.

Poecilocapsus goniphorus Say, 17 Aug. from Mrs **E. B. Smith,** Coeymans N. Y.

Capsus (Rhopalotomus) ater Linn. from **G. W. Kirkaldy,** Wimbledon Eng.

Phymata wolffii Stäl. 23 June; from Mrs **E. B. Smith,** Coeymans N. Y. Same, 4 Aug.; from **H. W. Gordinier,** Troy N. Y. Eggs of ?same, 6 Mar.; from **J. Thompson,** Cobleskill N. Y.

Eggs of Acholla multispinosa DeGeer, 6 Mar.; from **J. Thompson,** Brighton N. Y. Adults of same, 15 Aug.; from **O. Q. Flint,** Athens N. Y. Same, 24 Aug.; from **Mary E. Hanks,** Kanona N. Y. Same, 26 Aug.; from **F. J. Riggs,** Albany N. Y. Same, 29 Aug.; from Mrs **E. B. Smith,** Coeymans N. Y.

Wheel bug, Prionidus cristatus Linn. 21 Oct.; from Philadelphia Pa. Sent by Mrs **E. C. Anthony,** Gouverneur N. Y.

Masked bed bug hunter, "kissing bug," Opsicoetus personatus Linn. 15 July; from **J. G. Linsley,** Oswego N. Y. Same, 15 July; from **Dr S. G. Shanks,** Albany N. Y. Same, 31 July; from **A. H. Wright,** Rome N. Y.

Pelocoris femoratus, Pal. Beauv. from America through **G. W. Kirkaldy,** Wimbledon Eng.

Giant water bug, Belostoma americanum Leidy, 24 July; from **Mary B. Sherman,** Ogdensburg N. Y. Same, 27 July; from **Harry Alexander,** Albany N. Y. Same, 4 Aug.; from **Herrman Dresser,** Albany N. Y. Same 15 Aug.; from **J. Berberick,** Albany N. Y.

Benacus griseus Say, 31 May; from **Dr A. M. Young,** Salem N. Y. Same, 1 June; from **J. A. Sweeney,** Albany N. Y. Same 9 June; from Miss **E. P. Dennison,** Binghamton N. Y.

4 Ilyocoris (Naucoris) cimicoides Linn., 4 Nepa cinerea Linn., 4 Notonecta glauca Linn., 1 Notonecta insulata W. Kirby, 4 Corixa praeusta Fieb. from **G. W. Kirkaldy,** Wimbledon Eng. Notonecta americana Fabr. adult and ova, probably from Mexico, 2 lots of Notonecta undulata Say, probably from America, Notonecta undulata var. from Jamaica, Corixa mercenaria Say, ova and adult, probably from Mexico; all through **G. W. Kirkaldy,** Wimbledon Eng.

Hog louse, Haematopinus urius Nitz. from pigs, 25 May from **Rhoda Thompson,** Ballston Spa N. Y.

17 year cicada, Cicada septendecim Linn. 1 June; from **W. R. Houston,** Geneseo N. Y. Same 9 June; from **J. Jay Barden,** Union Springs N. Y. Same 17 June, from Onondaga Valley; from Miss **A. M. Armstrong,** Belle Isle N. Y. Same from Penfield N. Y. 21 June; from **M. S. Baxter,** Rochester N. Y.

Cicada tibicen Linn, (2) one just emerging from pupa, 21 July; from **Frank Nicholl,** Albany N. Y. Same, 29 July; from **Rev. W. H. Roberts,** Utica N. Y. Same, 29 July; from **J. A. Otterson,** Berlin Mass. Same, 17 and 29 Aug.; from Mrs **E. B. Smith,** Coeymans N. Y. Same, 12 Sep.; from Miss **A. M. Armstrong,** Belle Isle N. Y.

Ormenis pruinosa Say on currant bushes, 31 July; from **C. H. Peck,** Menands N. Y.

Fulgora coccinea Walk. from Ceylon, through **G. W. Kirkaldy,** Wimbledon Eng., Eupteryx atropunctata Goeze, Deltocephalus abdominalis Fabr., Thamnotettix subfusculus Fall. and T. prasinus Fall., all from **G. W. Kirkaldy,** Wimbledon Eng.

Two spotted tree hopper, Enchenopa binotata Say, on Celastrus scandens, 5 July; from **M. Goldman,** Pittsfield Mass.

Ceresa diceros Say, 10 Aug.; from **G. S. Graves,** Newport N. Y.

Telamona ampelopsidis Harr. 30 June; from **Harry W. Riggs,** Albany N. Y. Same, 5 July; from **F. J. Riggs,** Albany N. Y.

Chermes abietis Linn. on spruce 25 Aug.; from Mrs **A. G. Fisher,** Batavia N. Y.

Pemphigus acerifolii Riley, 27 July; from **H. N. Otterson,** Bolton Mass.

Galls of Pemphigus ulmifusus Walsh on slippery elm, 30 June; from **G. A. Jackson,** Catskill N. Y.

Cockscomb elm gall, Colopha ulmicola Fitch, 21 June; from **M. T. Willis,** Sandyhill N. Y.

Woolly apple aphis, Schizoneura lanigera Hausm. 2 Dec.; from **C. C. Coe,** Ridge Mills, N. Y. through state department of agriculture. Same on apple, 12 Sep.; from **S. L. Frey,** Palatine Bridge N. Y. Apple limb badly infested with same, 18 Sep.; from **Virgil Bogue,** Albion N. Y.

Schizoneura americana Riley, on elm, 20 June; from **Mary B. Sherman,** Ogdensburg N. Y.

Callipterus betulaecolens Fitch, on birch, 20 June; from **M. F. Adams,** Buffalo N. Y.

?Melanoxanthus salicis Linn. on Russian willows, 6 Sep.; from **T. Guilford Smith,** Buffalo N. Y.

Aphis rumicis Linn. on Euonymus europaeus, 15 May; from **Gertrude Kellogg,** Port Kent N. Y.

Aphis viburni Scop., 25 May; from **Rhoda Thompson,** Ballston Spa N. Y.

Apple aphis, Aphis mali Fabr. on apple, 11 May; from **W. A. Lafler,** Albion N. Y. Same, 20 May, from **Ruth Sherwood,** Fishkill N. Y. Same, 4 June; from **C. L. Allen,** Floral Park N. Y.

Nectarophora destructor Johns. injuring peas, 7 July; from **C. L. Allen,** Floral Park N. Y.

Pseudaonidia species on Camellia japonica, 5 Jan. from New York, through state department of agriculture.

Gossyparia ulmi Geoff. on Ulmus campestris, 6 June, from Flushing L. I., through state department of agriculture.

Maple leaf scale insect, Pseudococcus aceris Geoff. on maple leaves with active young, 20 Sep.; from **O. Q. Flint,** Athens N. Y.

Asterolecanium quercicola Bouché on English oak, 25 Feb. from **G. G. Atwood,** Geneva N. Y. Same on oak, 15 May; from **M. F. Cleary,** Cortland N. Y.

Lecanium pruinosum Comst. MS. Coq. on grape vines, 31 Oct. from Brighton N. Y. through state department of agriculture.

Twigs of Magnolia soulangea badly infested with Lecanium tulipiferae Cook, 19 Oct.; from Fishkill on the Hudson; from **Leonard Barron,** New York.

Lecanium armeniacum Craw. on English gooseberry, 12 Ap; from **G. G. Atwood,** Geneva N. Y. Same, 3 May; from Brighton N. Y. through state department of agriculture.

Lecanium cerasifex Fitch on peach, 6 Ap.; from **G. G. Atwood,** Geneva N. Y.

English ivy badly infested with the white scale, Aspidiotus nerii Bouché, 29 Dec. from **W. S. Eager,** Berlin Mass.

San José scale, Aspidiotus perniciosus Comst. on willow and several shrubs, 28 Ap.; from Mrs **E. H. Mairs,** Irvington on the Hudson N. Y. Same on apple, 17 Aug.; from **W. B. Dupree,** Centerport N. Y.

Aspidiotus ancylus Putnam, 3 May, from Brighton N. Y.; on Prunus, 19 May from New York; on Betula alba and on Ilex verticillata at Flushing L. I. 26 May; on hemlock, 1 Aug.; on apple twigs, 4 Jan. and 15 Mar. from Brighton N. Y; on currant, 30 Aug. from Geneva N. Y.; all through state department of agriculture. Same on mountain ash, 28 Aug.; from **H. C. Peck,** Brighton N. Y. Same on currant, 22 Aug.; from **P. L. Huested,** Blauvelt N. Y.; 3 Mar.; from **J. Jay Barden,** Stanley N. Y.; 27 Aug.; at Lodi N. Y.; from same.

English oyster shell bark louse, Aspidiotus ostreaeformis Curtis, on apple, 3 Dec. and 3 Feb. from Geneva N. Y. through state department of agriculture; 23 Feb.; from **H. C. Peck,** Brighton N. Y.; 6 Mar.; from **J. Thompson,** Brighton N, Y.; 10 Ap. and 27 Aug.; from **J. Jay Barden,** Stanley N. Y.; 10 Aug.; from near Kinderhook N. Y. through **P. L. Huested**; on dwarf apple, 24 Feb.; from **H. C. Peck,** Brighton N. Y. Probably same on plum, 25 Feb.; from **G. G. Atwood,** Geneva N. Y. and 2 Mar.; from **C. H. Darrow,** Geneva N. Y. Same on plum, 22 May, from **James Buckley,** Lewiston N. Y. through **Henry Lutts,** Youngstown N. Y.; on European plum, 15 Mar.; from Geneva N. Y. through state department of agriculture. Same on cherry, 25 Mar.; from Geneva N. Y. through same,

and 27 Aug. from **J. Jay Barden,** Stanley N. Y. Same on pear from Brighton N. Y. 22 June, through state department of agriculture; 10 Aug.; from near Kinderhook N. Y. through **P. L. Huested;** 28 Aug.; from **H. C. Peck.** Same on elm and on purple leaved plum 22 Aug.; from **P. L. Huested,** Blauvelt N. Y. Probably same, 4 Ap.; from **T. C. Maxwell Bros.** Geneva N. Y. through **G. G. Atwood.**

Peach scale, Diaspis amygdali Tryon, 23 Jan.; from **L. O. Howard,** Washington D. C.

Rose scale, Aulacaspis rosae Sandberg on rose twigs from Baltimore Md. 5 Dec.; from **Leonard Barron,** New York.

Parlatoria viridis Ckll. on recently imported Japanese maples; stock seized by state department of agriculture, 28 Mar. Same on Japanese maples 29 June; from Brighton, through state department of agriculture.

Parlatoria pergandii Comst. on tangerine, 5 Jan.; from New York, through state department of agriculture.

Apple tree bark louse, Mytilaspis pomorum Bouché, 5 Dec.; from **Dr J. B. Washburne,** Delmar N. Y. Same on apple, 25 Feb.; from **G. G. Atwood,** Geneva N. Y. Same, 3 Mar.; from **J. Jay Barden,** Stanley N. Y. Same, 15 Mar.; from Brighton N. Y. through state department of agriculture. Same, 11 May; from **H. C. Peck,** Brighton N. Y. Same on apple and willow, 5 Aug.; from **Dr S. A. Russell,** Poughkeepsie N. Y. Same, on ash, 7 Mar.; from **Isaac Hicks & Son,** Westbury Station N. Y. Same, 28 Ap.; from Mrs **E. H. Mairs,** Irvington on the Hudson N. Y. and 23 May; from **W. B. Diamond,** Montgomery co. Md.

Chionaspis pinifoliae Fitch on pine, 25 Feb.; from **G. G. Atwood,** Geneva N. Y. Same 31 May; from **E. T. Schoonmaker,** Albany N. Y.

Scurfy bark louse, Chionaspis furfurus Fitch, on pear, 25 Feb. from **G. G. Atwood,** Geneva N. Y.; 11 May; from **H. C. Peck,** Brighton N. Y. 1 Sep.; from **J. O. Carleton,** New York. Same on Pyrus japonica, Ap. from Hingham Mass. through **Leonard Barron,** New York. Same on crimson thorn, 7 Mar.; from **Isaac Hicks & Son,** Westbury Station N. Y.

Branches of Euonymus europaeus nearly covered with Chionaspis euonymi Comst. 19 Oct.; from Fishkill on the Hudson, from **Leonard Barron,** New York. Same on lilac, 19 Ap.; from **E. C. Powell,** Greatneck N. Y. Same on Prunus pissardi and other shrubs, Ap.; from Mrs **E. H. Mairs,** Irvington on the Hudson N. Y.

Physopoda

Onion thrips, Thrips tabaci Lind. on lettuce, 15 June; from **W. R. Houston,** Geneseo N. Y.; 1 July; from **G. S. Graves,** Newport N. Y.

Orthoptera

White flower cricket, Oecanthus niveus DeGeer, 17 Aug.; from Mrs **E. B. Smith,** Coeymans N. Y.

Small, striped, ground cricket, Nemobius fasciatus DeGeer, 8 Aug.; from **Rev. W. H. Roberts,** Utica N. Y.

Eggs of katydid, Microcentrum retinervis Burm. on grape; 25 Sep.; from **F. H. Hein,** Philadelphia co. Pa.

Ceuthophilus maculatus Say, male, 17 Aug.; from Mrs **E. B. Smith,** Coeymans N. Y.

Orchelimum vulgare Harr., 17 July; from **F. J. Riggs,** Albany N. Y.

Schistocerca rubiginosa Harr., 23 May; from **W. C. Hitchcock,** Cropseyville N. Y.

Periplaneta orientalis Linn, 21 July; from **Albert Kelly** and **Frank Riordan,** Albany N. Y.

Isoptera

White ant, Termes flavipes Kollar, infesting dwelling house, 30 Mar.; from **W. G. Lewis,** Trinity place, Albany N. Y.

Plecoptera

Leuctra species, 14 Ap.; from **Franklin Sherman jr,** Foresthome Tompkins co. N. Y.

Perla tristis Hagen, 21 June; from **W. C. Hitchcock,** Cropseyville N. Y.

Odonata

Anax junius Drury, male, 17 Aug.; from Mrs **E. B. Smith,** Coeymans N. Y.

Epiaeschna heros Fabr. female, 9 June; from Miss **B. E. Riggs,** Albany N. Y.

Plathemis trimaculata DeGeer, male, 12 June; from **Herman Sellnow,** Albany N. Y.

Thysanura

Thermobia furnorum Prov. 29 May; from Mrs **E. L. Strong,** Ogdensburg N. Y.

Arachnida

Nest of trap door spider, 25 Mar.; from **Eliza B. Torrey,** San Diego Cal.

Red spider, Tetranychus telarius Linn. on apple, 3 Feb.; from Geneva N. Y. through state department of agriculture.

Eggs of clover mite, Bryobia pratensis Garm. on apple twigs, 14 Jan. and 15 Mar.; from Brighton N. Y. through state department of agriculture.

Tyroglyphus ?siro Linn. abundant in wheat bran, 17 Aug.; from **M. Albert Morris,** Oneonta N. Y. through **W. C. Franklin.**

Phytoptus quadripes Shim., 23 May; from **W. B. Diamond,** Montgomery co. Md.

Myriapoda

Young of Julus caeruleocinctus Wood, injuring squashes, 6 July; from **C. C. Merriam,** Lyon Falls N. Y.

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References are given under preferred scientific names. The synonyms used in the text of the publications cited are placed in curves after the name, and the synonomy given applies only to these citations. The superior figure points to the exact place on the page in ninths: e. g. 608^2 means page 608 beginning in the second ninth of the page, i. e. about two ninths of the way down.

ERRATA

Page 534, line 17, for W. H. Gordinier, read H. W. Gordinier.

Page 539, line 4, for J. H. West, read J. E. West.

Page 611, line 6, page 614, lines 12 and 10 from bottom and page 617, line 9 from bottom, for J. Thompson, read J. Thomson.

(Pages 655–56 were bulletin cover pages)

Appendix 2

REPORT

OF THE

STATE PALEONTOLOGIST

1899

CONTENTS

REPORT

OF THE

STATE PALEONTOLOGIST

To the Regents of the University of the State of New York

The paleontologist has to report a satisfactory, active and harmonious period of service dating from the commencement of his duties in this capacity Jan. 1, 1899.

Reorganization and appointments

In reconstructing the geologic and paleontologic work of the state museum at their meeting on Dec. 15, 1898, and in making the appointment of state paleontologist, the regents specified the work of this official in the following terms:

The state paleontologist shall be charged with the collection and study of the fossils of New York and the classification of the rock strata containing them and shall conduct all necessary investigations pertaining to these subjects.

To illustrate his publications he may issue any necessary maps of the areas of fossiliferous rocks and shall be responsible for and accredited with the delineation on any geologic maps to be hereafter issued, of such geologic boundaries as have been determined by him.

At the same time your board provided for the continuation of the services of the staff of the late state geologist and paleontologist, Dr James Hall, to be under the supervision of the present state paleontologist; viz, George B. Simpson, draftsman, Philip Ast, lithographer, Jacob Van Deloo, clerk and stenographer, Martin Sheehy, helper; and also made provision for the appointment of a scientific assistant to the paleontologist. The position last named has been filled by the appointment of Rudolf Ruedemann Ph.D. of Dolgeville (N. Y.) a graduate of the University of Jena and former assistant to the professor of geology at

the University of Strasburg. Dr Ruedemann began his term of service Mar. 1 of this year. Throughout the entire staff there has been a marked feeling of harmony and earnest cooperation to advance the interests of the department.

Unfinished work of the old department

The death of Prof. James Hall on Aug. 7, 1898, at the great age of 87 years, left a large amount of work begun and brought to various degrees of progression. As his years increased, this remarkable man took no thought to bring his life's work to a close but continued to make plans, as had been his lifelong habit, on an elaborate scale, courageously taking little account of the time necessary for their completion, and not always calculating the expense involved in their execution. The lamented event of his death left in an incomplete condition the following reports: the 15th annual report (for 1895), the 16th annual report (for 1896), both of which were in press, the 17th (for 1897), which had been transmitted, and the 18th, or that for the year in which he died, which had not yet been rendered. These reports were all compendious documents, embracing the individual reports of various members of his staff, both permanent and temporary, and more or less elaborate contributions on paleontologic subjects requiring extensive illustration. Besides these was the *Memoir on the paleozoic reticulate sponges*, for the special edition of which provision had been made, and also a *Memoir on the genera of the paleozoic corals.*

By the direction of your board the completion of all this unfinished work of the old department of the state geologist and paleontologist was placed in charge of the paleontologist; and I have to report with regard to the progress of this work as follows:

Of the 15th report, volume 1 had been delivered previous to the death of Prof. Hall. Volume 2 has been completed and distributed, and the single volume of the 16th report is also completed, and is now in bindery. The 17th report is in press and the 18th is awaiting its turn.

The *Memoir on the paleozoic reticulate sponges,* which carries with it 70 lithographic plates of large quarto size, and is published in parts in the 15th and 16th annual reports, has been prepared for its special edition, which has required repaging, and is also ready for delivery. Under the special provision just referred to we are to receive 1100 separate copies of this memoir.

The memoir on the fossil corals was not far advanced at the time of Prof. Hall's death. The determinations of generic structure and the preparation of the illustrations had been largely left in the charge of Mr George B. Simpson, draftsman. The original scope of this work was far reaching and it was designed by Prof. Hall to be an analysis of all the paleozoic fossil corals occurring in the state of New York and the allied faunas outside the limits of the state. The group of organisms with which this important work has to deal is widespread throughout our older rocks and, on account of their abundance and somewhat complicated structure, they have never been exhaustively studied and are not well known. To carry out the original plan of this work would, in my judgment, require continued and close application for many years, and the illustration necessary to give the work its true value should be profuse. It will require the services of a student who has familiarized himself fully with all the literature in various languages on this subject if it is to take its place as a scientific work of genuine merit. As I have felt that the present equipment of this department would not permit the immediate execution of this scheme as originally planned, I proposed to your board that the work be continued along its present lines to the close of one of its natural divisions, leaving the other divisions of the subject untouched for the present. That is to say, that the work be continued to the completion of the division of the rugose corals. This proposition has been approved, and I have to report that the work has been carried forward in this way as rapidly as circumstances would permit. Some delay in its prosecution was caused by the fact that the material on which the study of these fossils was being made, largely belonged to the estate of the late Prof.

Hall and the executors could not for some time see their way to permit additional material to be lent from that collection. This matter was however eventually arranged with the executors, and I am pleased to report that the work in this form is well progressed.

Transactions with the executors of the James Hall estate

During the life of Prof. Hall and while paleontologic investigations were in active progress, there was always a considerable amount of material belonging to his private collection in the rooms of the state geologist and paleontologist, and on the other hand considerable property of the state museum in his possession at his private laboratory. I am pleased to report that the claims of the state museum on the one hand and of the Hall estate on the other have been in the main now satisfactorily adjusted. I have delivered to the executors of that estate all of the material in my charge that belonged to Prof. Hall and for which we had no farther use, and I have retained with their consent a limited amount of material pertaining to problems under study now and before the death of Prof. Hall. On the other hand I have received from the executors of that estate all the material in their possession to which it seemed possible to establish an undoubted claim and have signed in receipt the accompanying statement:

16 *Ap.* 1899

The articles herewith specified, the property of the New York state museum, have been this day delivered by the executors of the estate of Prof. James Hall, deceased, to the custody of the state paleontologist and receipt thereof is hereby acknowledged.

1 drawer of type specimens of fossils

1 drawer miscellaneous specimens of fossils

4 boxes unopened, marked as containing specimens exhibited at the New Orleans exposition

2 boxes unopened, marked as containing material for school collections

5618 original drawings, sketches and outlines of fossils

The material above specified is in full satisfaction of all claims yet made on behalf of the New York state museum against said estate.

Office work

Catalogue of type specimens. The type specimens, or those which have served the purpose of description and illustration, constitute a very important part of the wealth of any collection in natural history. It is to such material that scientific students must always have reference in establishing the value of identifications and comparisons, and it therefore has a value never equaled by that of other specimens even though the latter be of superior quality. It has been a matter of frequent statement that many of the original specimens described in the various volumes of the *Paleontology of New York* are absent from the state museum collections, that such types have gone to other institutions, or that the original material has been lent by various institutions and individuals for the purpose of illustration. These statements are to a certain extent true, and the loaning of specimens must often be the procedure in the execution of any thoroughgoing and complete series of investigations. The paleontologic collections of the museum however contain far more of these types than has been generally supposed or conceded; and, as a careful record of these important specimens has never been kept, I have made it a part of my first work to prepare a complete catalogue of them, in continuation of partial lists prepared by the writer some years ago. This cataloguing, which involves a record of the place in which each type specimen has been described and illustrated, has gone forward with reasonable rapidity, and is already sufficiently advanced to show that within the organic groups, crustaceans, annelids, cephalopods and brachiopods, the collections contain about 2300 types. On the completion and perfection of this catalogue, it is my purpose to offer it for publication as a permanent record, as has been done in other scientific museums.

Electrotyping. In addition to the original specimens themselves, the collections contain a considerable number of replicas of type specimens in plaster of paris and gutta-percha. Experience has shown that such replicas become injured or destroyed in course of time, and it has therefore seemed wise to adopt means

for preserving these in more permanent form. Dr Ruedemann has taken charge of the electrotyping of such material, and we are now getting copper replicas of these types which will withstand destructive agencies.

Preservation of plaster casts. Many of our plaster replicas of type specimens are too large for satisfactory electrotyping. These are being hardened and rendered more durable by treatment with ammonium borate.

Record of localities. No systematic record of localities of collections of fossils made previous to the year 1857 exists. All specimens of fossils added to the state museum from American localities have since that date been marked by tickets of orange paper attached to them and bearing numbers referring to localities as entered on the record. With very few exceptions no foreign localities have been entered on previous records. In the copy of the first book of record made about 1873 is the following memorandum: "This book contains a record of the collections of fossils made for the paleontology of the state and for the state museum of natural history either by myself or by persons employed by me; and all collections made with means or money in any way provided by the state, so far as yet arranged, are here recorded. Every specimen is marked with an *orange colored* ticket on which is written or printed a number after the manner of those appended below. These numbers refer to localities which are described under the corresponding numbers on the pages of this record. An alphabetical index of localities with reference to the numbers is likewise added, occupying pages 1–26 inclusive. James Hall."

The locality numbers of this early record were consecutive from no. 1 upward and the localities were entered without special regard to geologic sequence. This record closed with the number 900. The continuation of the record thereafter began with the number 1001; and, with the purpose of entering localities according to geologic sequence, an assignment was made of definite locality numbers to each geologic formation. Thus 100 numbers were

allowed to the Primordial, 150 to the Upper Silurian, 150 to the Lower Devonian (to Hamilton group) 200 to the Middle Devonian (Hamilton group), 200 to the Chemung group and 50 to the Catskill group. These apportionments provided for consecutive numbering up to the number of 2000. This provision has not proved sufficiently elastic. Some of the apportionments of numbers have long been entirely filled, and a duplication of the localities by the addition of letters (a, b, c, etc.) has been necessary. In continuing this record, it is purposed to add localities irrespective of stratigraphic sequence and to assign to new localities of whatever stratigraphic age numbers above 2000. In order to bring together in one place all numbers pertaining to a given formation, a catalogue of such formations has been here prepared. This with the completed catalogue of localities alphabetically arranged precedes the record proper.

In 1878 Prof. Hall instituted a separate record of American localities of fossils outside the state of New York, using to designate such specimens a circular orange ticket. Only about 20 such entries were made, and, as many of such extralimital localities had already been entered on both earlier and later records, I have abandoned this record by assigning to each entry a number in the general record and have appended a list of these old numbers with their new equivalents. The actual number on the tickets has not been changed. This list also precedes the general record.

All previous locality records had been carried in various books, and they have now been transcribed to one volume with the changes above suggested, and the list indexed both for the localities and formations. This work has been very carefully executed by Mr Van Deloo. It has been also necessary in transcribing this record to revise it, as many changes have been found necessary both in the sames of localities and characterization of formations. Every entry has therefore been carefully considered and corrected or verified as far as possible. Taken as a whole, this catalogue affords the most complete list extant of the fossiliferous localities in the state of New York and with its

locality and formation indexes will prove very serviceable to students of New York paleontology everywhere. For this reason I communicate herewith a copy of this catalogue for publication as a part of this report.

General paleontologic collection in the state hall. This collection consists of a very large amount of material contained in 3547 drawers and eight large table cases, with an overflow packed in 444 large boxes of various sizes, and one stack holding a ton or more of slabs. The material in boxes is that for which no drawer space can be found or which has been put aside because of inferior quality. When this collection was installed in its present quarters in 1886, a systematic arrangement of the principal part was then initiated and in part carried out. Since that time however very little labor has been expended on the careful selection of material from this immense store, which should serve the ultimate purpose of a reserve for the exhibition collections of the museum. These drawers contain good and bad alike. From this supply collections of fossils were for many years made up for the use of schools, and, as a natural consequence, specimens of fair and good quality being always taken for this purpose, the general collections now contain a large residuum of inferior and to some extent worthless material commingled with that of better quality. It has been my desire to have all of this material carefully and systematically studied for the purpose of setting aside a permanent reserve of superior specimens to illustrate the fossil faunas of the state, a reserve which shall be kept absolutely free from farther encroachment; and at the same time to eliminate from this disordered mass all material of lower grade which may be assigned to purposes of exchange or to meet other demands. This is a work requiring much time but one which I regard of first importance to the quality of our collections. It will serve to show not only the points in which the collection is strong and well represented but also the respects in which our representation is weak and in need of addition. It will furthermore contract the space occupied by the collection and afford much needed room for the constant accessions. In this work of revision of the gen-

eral collection it is intended that all material now scattered through other drawers and special collections shall be distributed in its proper place and the disorder which has increased with years be done away with. With the assistance of Dr Ruedemann an excellent beginning has been made of this work. A permanent, carefully identified and labeled reserve is being set aside, which will be ready for prompt installation in the exhibition collection whenever the opportunity arrives.

Of the large number of boxes, all are labeled and systematically arranged. By means of the record kept of them any one can be found without trouble.

Accessions. Reference to the detailed list of accessions during the past eight months will serve to indicate the great demand on the department for space. All drawer space is now taken and, with the addition of new material pertaining to some subject under study or requiring immediate investigation, accommodation can be found only by emptying some of the drawers already filled and packing their contents into boxes. The recording and ticketing of this new material, of which the department has received since Jan. 1 several thousand specimens, is essentially completed.

Lack of space. This is a constantly growing embarrassment, as must be evident from the foregoing statements. All the rooms occupied by the department on the third floor of the State hall are filled to overflowing and boxes are stored wherever space can be found, in the offices, corridors, but principally in the two rooms controlled by us in the basement of this building. This choked condition ought to constitute a strong argument for quarters which will do better justice to the state and this science. Despite the actual riches of our museum, we shall be at a disadvantage in reaching either the scientific student or the general public as long as we are compelled to remain in insufficient, obscure and unattractive quarters.

Publication. The completion of the 15th and 16th annual reports of the state geologist and paleontologist and the *Memoir on the paleozoic reticulate sponges* has required a large expenditure

of time in careful and oft repeated proof-reading. It has already been stated that the 17th annual report is now printing and the 18th or final report awaiting printing. In addition to these publications the paleontologist has issued the following:

University handbook 13, *Paleontology*

University handbook 15, *Guide to excursions in the fossiliferous rocks of New York state*

There is now in press a bulletin containing these papers: The Lower Silurian system of eastern Montgomery co.; Notes on the stratigraphy of the Mohawk valley and Saratoga co., by E. R. Cumings and C. S. Prosser, and I communicate herewith the manuscript of an additional bulletin covering the following subjects:

A remarkable occurrence of Orthoceras in the Oneonta sandstone of Chenango co.

The water biscuit of Squaw island, Canandaigua lake

Paropsonema, a peculiar echinoderm from the Intumescens-zone of western New York

Dictyonine hexactinellid sponges from the Upper Devonic

Also the manuscript of a memoir by the paleontologist entitled the *Fauna of the Oriskany formation in the state of New York*, and that of a *General record of the localities of American paleozoic fossils belonging to the state museum.*

The paleontologist also has in course of preparation a handbook of the paleontology of New York. This, which it is hoped may prove a useful publication, is one requiring much careful thought and labor and its progress must be cautious and consequently slow.

Investigations

Among the subjects which have received protracted study are the following:

The hydraulic limestones of western and central New York

The extensive series of hydraulic limestones which lie above the gypsum of the Salina beds have in times past been variously referred either to the Salina below or to the Helderbergian above. With the purpose of ascertaining all organic or

stratigraphic evidence pertaining to the proper age of these rocks, careful investigations have been made through the central and western counties. The problem is by no means a simple one, as fossil remains are for the most part meager and the succession of the beds has been generally regarded as gradual and uninterrupted. Our recent investigations have shown that the deposition of these hydraulic limestones was continued without interruption upward through what has commonly been regarded as the lower term of Helderbergian time, i. e. the Tentaculite limestone. The fauna of the Tentaculite limestone makes its first appearance not far above the gypsum beds, and in its most perfect development it is clearly an uppermost Siluric fauna, having only very remote relations with the fauna of the remaining divisions of the Helderbergian group in eastern New York. The inference that the upper limit of the Siluric system is properly to be placed at the top of the Tentaculite limestone is corroborated by stratigraphic structure which shows in places distinct unconformity between the Tentaculite limestone and the overlying strata. I regard the result of these investigations as of much importance in indicating the proper line of division between the Siluric and Devonic systems in the state of New York and as corroborating the views expressed by the writer at various times during the last 10 years. One outcome of these investigations is to establish the profuse fauna of the Helderbergian of eastern New York as an earliest Devonic rather than a latest Siluric fauna.

Oriskany fauna of Becraft mountain, Columbia co. This fauna is one of the more recent discoveries among our paleozoic rocks and presents a number of problems of special interest. The fauna itself is a noteworthy combination of species, many of its elements being heretofore unknown. Its character and composition show that it constitutes the deep water or calcareous facies of the fauna of Oriskany time, the common Oriskany species being in great part shoreward migrants which became involved in more sandy sediment. The relation of this subject to the problem just stated is intimate, as the character of the fauna

shows its close affiliation with that of the Helderbergian, as well as with those of later Devonic age. For this reason it has seemed important to present in detail an account of this fauna at its best development, as has been done in the memoir herewith submitted.

Fauna of the Portage beds. Investigations carried on for a number of years past have shown that the organic constitutents of the Portage beds are very imperfectly known. The group of strata deposited in Portage time has been shown to represent at least three distinct faunal provinces and presents problems in the geographic distribution and dispersion and in the evolution of ancient faunas unexampled in our paleozoic rocks. The western Portage province, or that developed through the counties of the state from Seneca to Chautauqua, has proven of exceptional interest, as it carries a very large number of forms, heretofore undescribed, which bring it into close relationship with faunas of like geologic age in Germany and Russia. It is probably the most complete and unmodified reproduction of a European fauna yet observed in the paleozoic rocks of America. In the 16th annual report of the state geologist (1896) the writer published a first instalment of the results of these investigations, entitled "The Naples fauna (fauna with Manticoceras intumescens) in Western New York," prefaced by a geologic introduction and covering the Goniatitinae, (165 pages and nine plates). The investigation of this problem has been continued, analyses of a considerable number of other species have been prepared and a substantial number of drawings illustrating the species have been completed.

Faunal colonies in the Clinton beds. In western New York, through Orleans and Niagara counties, occur lenticular masses of limestone from 10 to 30 feet in diameter and entirely disconnected, these in one place lying embedded in the midst of the Clinton limestone, though of wholly different texture and composition therefrom; in another, resting on the top of the Clinton limestone; and in still another, lying in the shales above the limestone and displacing or being surrounded by the

lower shaly beds of the Niagara group (Rochester shales). These lenses retain, frequently in fine preservation, a fauna in marked distinction to the fauna of the Clinton beds. The fossils are associated species from the Clinton fauna below and the Niagara fauna above, with a considerable number of species not before known in the state of New York but represented heretofore only in the Niagara fauna of the interior states. The problem presented by this very peculiar occurrence is one which requires careful consideration and will doubtless prove of much interest in elucidating the origin and mode of distribution of our fossil faunas. The subject was first brought to public notice some 10 years ago by Dr E. N. S. Ringueberg of Lockport, who deserves the credit for recording this interesting occurrence at some of the localities observed and for the identification of a considerable number of the species. Though Dr Ringueberg discontinued his study of the problem with a single publication, I have the hope of reenlisting his interest in the topic.

The graptolite faunas of the lower rocks. In Great Britain and Scandinavia, the variations in the succession and composition of the graptolites in the older faunas have served as a basis of classification of the rock strata. The graptolite faunas of New York have never been fully studied from the point of view of their stratigraphic importance. Dr Ruedemann, who before his connection with the museum staff had devoted much time to the careful investigation of the structure of the graptolites and is the author of some important papers bearing on these fossils, has taken up for special investigation the study of the graptolites of New York, their anatomy and geographic and vertical distribution through the rocks. It is a problem of far reaching importance and one that will require time and patience for its elucidation. Dr Ruedemann's statement concerning his field work on this subject during the past season is given on a following page.

Areal work and the coloring of topographic sheets. I have communicated for publication one of the topographic quadrangles colored to represent the distribution of the fossiliferous rocks. This is the Amsterdam sheet prepared by Professors Prosser and

Cumings. We are also prepared to color with very little additional work, the quadrangles of Phelps, Canandaigua and Naples as soon as these topographic sheets are issued. So long as the paleontologist is dependent on his small appropriations for the prosecution of this work of coloration on the scale used in the United States atlas sheets, progress in this regard toward the perfection of the general geologic map of the state will be very slow. He must either look to the legislature for a more generous provision for field work or to cooperation with the director of the United States geological survey.

In addition to the subjects mentioned above, the necessary investigations have been carried on for the preparation of the shorter papers communicated in the bulletin of the state museum as above mentioned, and which were in part presented by the paleontologist as subjects for discussion at the Columbus meeting of the American association for the advancement of science, in August.

Field work of the paleontologist and assistants

Vertical Orthoceras at Oxford. Visits have been made to the F. G. Clarke Co.'s quarries at Oxford and South Oxford for the purpose of studying the remarkable occurrence of the cephalopod Orthoceras in the strata there. These shells, as I have described in an accompanying paper, occur by thousands in a vertical position in the strata, where they represent the only truly marine fossil in these sediments on the Oneonta formation. The mode of occurrence is unique, no other such instance having, to my knowledge, been before observed. This vast army of these ancient nautiloids was apparently destroyed by being driven into the Oneonta area of fresh or brackish water.

Nematophytum at Monroe. Two or three years ago the writer urged on the late state geologist and paleontologist the importance of securing for the museum a specimen of so-called "fossil tree" from the Hamilton rocks at Monroe, Orange co. The fossil had been found on the farm of O. H. Cooley, whose father had years ago sent specimens to Prof. Hall for examination. It represents a great trunk-like seaweed of the genus

Nematophytum, which has, by the favor of Prof. D. P. Penhallow of McGill university, been identified with his Nematophytum logani. When originally found, the length of this alga was 24 feet. Visitors during a number of years carried away parts of the trunk, till at the date referred to only about 12 or 14 feet remained. As a result of the writer's suggestion, the specimen was obtained by the director of the state museum and now makes a striking specimen in its collection. Subsequently Mr Cooley uncovered several more such great trunks, and the writer has visited the locality to see if any of them would be a material addition to that which we already have. The other specimens however are much shorter and less perfectly preserved, and it has therefore seemed unnecessary to incur expense in order to acquire additional examples of this great seaweed.

Oriskany section at Schoharie. Investigations have been made at Schoharie to elucidate the detailed succession of the rock strata above the top of the Helderbergian formation.

Hydraulic limestones. In company of D. D. Luther, special field assistant, some time has been spent in studying the character of the hydraulic limestones and the beds above them in the vicinity of Union Springs, Cayuga co., where important collections and interesting results were obtained.

Investigations were also made in Erie co., with results which have an interesting bearing on the problem of the dividing line between the Siluric and Devonic systems.

Hydraulic and Marcellus limestones in Onondaga co. D. D. Luther, special assistant, has continued his investigations of the hydraulic limestones and their fauna eastward into Onondaga co., and in connection therewith has made observations on and collections from the Agoniatites limestone of the Marcellus beds. The latter investigations have been for the purpose of determining whether or not this remarkable limestone is continuous with the Stafford limestone of the Marcellus beds, which appears at its best development at localities in western New York where the Agoniatites limestone has lost its characteristic features. The

result of the work has been to demonstrate that the two beds are altogether distinct, the Agoniatites limestone passing downward and, in the neighborhood of Flint creek in Ontario co. becoming complicated with the upper layers of the Corniferous limestone, while the Stafford limestone, which appears not farther east than Ontario co. and continues westward to Lake Erie, occupies a higher position in the strata. The faunas of the two strata are remarkably dissimilar.

Clinton colonies in Orleans and Niagara co. As already observed the colonies contained in the lenticular limestones of the Clinton beds through Orleans and Niagara co., have been studied. Here also quite extensive collections were made, particularly from the Clinton shales in the vicinity of Gasport and in the Niagara shales near Middleport.

Newburgh mastodon. About the middle of August notice was received of the discovery of a mastodon on the farm of F. W. Schaeffer, three miles west of Newburgh. The spot was visited at once and an option obtained from the owner on behalf of the state museum which would secure first consideration at the sale of the skeleton. At the present writing the specimen appears to be fairly complete in excellent preservation and negotiations are now under way to secure it in case it proves a desirable acquisition.

Graptolites in Colonie. The writer may also report the interesting discovery of graptolites in remarkably fine preservation in the Hudson river shales at the Albany rural cemetery, not far from the grave of Prof. James Hall. With the consent of the superintendent of the cemetery, a very considerable amount of this exceptionally fine material has been secured.

Graptolites in Columbia, Albany and Rensselaer co. Dr Ruedemann, assistant in paleontology, has carried on field investigations bearing on the distribution of the graptolites, first at Mt Moreno, south of the city of Hudson, where with Mr Sheehy very considerable collections were made, and subsequently at various localities between Albany and Schenectady and in the vicinity of Troy.

Dr Ruedemann has prepared the following statement of his work:

A large amount of graptolite-bearing shales was at the beginning of June collected at Mt Moreno near Hudson. The fauna is nearly related to that made known by Prof. Hall from Normanskill. The latter locality is, however, concealed while the material from Mt Moreno not only contains several new forms and many forms not observed at Normanskill, but also the Normanskill graptolites in such a good state of preservation that the true character of forms left in doubt by the Normanskill material, such as Lasiograptus, can be elucidated and certain doubtful features, as the appendages of Diplograptus whitfieldi, described as "gonangia," can be studied to greater advantage.

The finding of this fauna suggested a new inquiry into the age of these shales regarding which widely differing opinions are held by paleontologists. With a view to gathering new information on this problem, the writer has begun to visit all outcrops of shales in the region along the Hudson river where this shale occurs. The outcrops along the Normanskill and its branches have been studied as far as French's mills and graptolites and other fossils found in several localities. The graptolites in the quarry in the Rural cemetery near Albany have been collected and the outcrops around Cohoes, Waterford, Lansingburg and Troy have been visited. The study of the faunas of these different localities will allow a conclusion, it is hoped, as to the age of the shales in question. It will be further necessary to investigate the stratigraphic relation of the Normanskill shales to the so-called "Hudson river shales" of the Mohawk valley along the creeks emptying into the Hudson river from the west, notably along the Coeymanskill, the Vlaumanskill and the lower Mohawk river.

Oriskany section at Kingston. Gilbert Van Ingen, of Columbia university, accompanied by Dr Ruedemann, has made a careful and very detailed record of the succession of the strata from the top of the Helderbergian formation through the Oriskany in the vicinity of Kingston and Rondout. This work has an important bearing on investigations pertaining to the line of divison between the Siluric and Devonic systems and has also resulted in the acquisition of a large number of superior specimens of Oriskany fossils, comparable to the celebrated fossils of this age at Cumberland (Md.)

Lower Siluric faunas of the Lake Champlain basin. Mr Van Ingen for a number of years past has been carrying on investigations relating to the succession of faunas in the Calciferous, Chazy and Trenton limestones of the Lake Champlain basin. This is an area of these early rocks which has heretofore received comparatively little attention, where the faunas are profuse and the fossils fairly well preserved. On account of the fact that, when Prof. Hall's original descriptions of these faunas were published, he was obliged to depend very largely on his private resources for the material on which his investigations were based, the state museum has an insufficient representation of these important early faunas, and Mr Van Ingen has consented to carry on his investigations under the auspices of this department with the understanding that the museum shall become the owner of all the material collected. With Dr Ruedemann, Mr Van Ingen has worked in this territory, and we have the assurance of very profitable material returns from this work as well as important contributions to the knowledge of the older rocks when the results of these investigations shall have been published.

1 *Oct.* 1899

Respectfully submitted

JOHN M. CLARKE

State paleontologist

APPENDIX 1

ACCESSIONS

The additions to the paleontologic collections have been by donation, purchase, exchange and collection. I submit herewith a detailed statement of these acquisitions.

Donations

Carll, John F., Pleasantville, Pa.

Fossils from the Waverly beds, Pleasantville

Calathiospongia carlli H. & C.	2	(types)
Other specimens	10	

Bennett, Lewis J., president Buffalo cement co., Buffalo, N. Y.

Waterlime crustacea from cement company's quarries at Buffalo	38	

White, David, Washington, D. C.

From the Catskill beds, Coxton, Pa.

Fossil ? bodies of unknown nature	13	

Rominger, C., Ann Arbor, Mich.

Romingerina julia Winchell, Pointe aux Barques, Mich.	12	(1 type)
Syringothyris texta, Keokuk beds, Ind.	2	
Tetradium barrandii, Konieprus, Bohemia	1	
Stromatocerium sp., Ann Arbor, Mich.	1	

Billings, Walter R., Dep't public works, Ottawa, Can.

Camarella panderi, Black river, Pauquette's rapids	9	(2 types)
C. volborthi, Black river, Pauquette's rapids	10	(1 type)
Other Siluric brachiopods from Canadian localities	23	

Perkins, G. H., Burlington, Vt.

Specimens from the Chazy limestone, Phillipsburg, Quebec and Fort Cassin, Vt. 20

Safford, James M., Nashville, Tenn.

Siluric brachiopods from east Tennessee 183 (8 types)

The types donated by Prof. Safford are of the following species:

S c e n i d i u m h a l l i Safford

O r t h i s h o l s t o n i Safford

O. s a f f o r d i H. & C.

O. a r q u a r i a H. & C.

O. s t o n e n s i s Safford

Hall, E. B., Wellsville, N. Y.

Specimens from the Chemung beds of western New York, mostly crinoidal 52

Dawson, J. William, Montreal, Can.

Specimens from the upper Siluric, Anticosti island, the Niagara at Hamilton, Ontario, the Clinton of Ontario, the Helderbergian of Cape Breton and the Quebec beds of Point Levis 23

F. G. Clarke bluestone co., Oxford, N. Y.

Large blocks of Oneonta sandstone with vertical O r t h o c e r a s 2

Jones, Robert W., Catskill, N. Y.

D i c t y o n e m a and other Helderbergian fossils from Catskill 3

Oriskany fossils, Catskill 6

Lincoln, D. F., Geneva, N. Y.

Rare species from the Onondaga limestone, Waterloo, N. Y. 7

Total by donation 417

Purchase

Bishop, I. P., Buffalo, N. Y.		
Arthrophycus harlani, Medina sandstone, Lewiston	5	
Tiffany, A. S., Davenport, Ia.		
Type specimens of the following species of Dictyospongidae:		
Lebedictya crinita H. & C.	2	(types)
Acloeodictya marsipus H. & C.	6	"
Calathiospongia carceralis H. & C.	1	(type)
Clathrospongia tiffanyi H. & C.	1	"
Also specimens and fragments of Physospongia dawsoni Whitf. P. colletti Hall Dictyospongia magnifica H. & C. Cleodictya mohri Hall etc.	27	
all from Crawfordsville, Ind. with the exception of Clathrospongia tiffanyi, Waverly beds, O.		
Sarle, Clifton J., Rochester, N. Y.		
A collection of crustacea from the base of the Salina beds in the town of Pittsford, Monroe co., about	900	
This important acquisition contains material which is entirely new to science and represents a remarkable contribution to the fossil faunas of New York state. Mr Sarle has made this material the basis of a careful study and description of these fossils, and therefore it includes all of the original specimens of the various species which he proposes to describe from the fauna. It is an acquisition of great scientific interest.		
Total by purchase	942	

Exchanges

Randall, F. A., Warren, Pa.	
Crustacea from the Chemung beds, Warren	14
Lepidechinus, Spiraxis	2
Nylander, Olaf O., Caribou, Me.	
Fossils from the Utica slate, Chapman plantation, Aroostook co., Me.	4
Clinton group, Castlehill, Aroostook co. Me.	33
Helderbergian beds, Square lake, Me.	70
Helderbergian beds, Ashland, Me.	18
Devonic, Chapman plantation, Aroostook co. Me.	54
Devonic, Chapman plantation, Me.	11
Devonic, Mapleton, Aroostook co. Me.	6
Bennett, John, Pittsburg, Kan.	
Carbonic fossils from Kansas City, Mo. and Lecompton, Kan.	60
Total by exchange	272

Collection

The paleontologist. Fossils from the Oriskany, West mountain, Schoharie	20
The paleontologist and R. Ruedemann. Graptolites from Hudson river slates in the Rural cemetery	200
The paleontologist and D. D. Luther. Fossils from the waterlimes and uppermost Siluric, Union Springs	168
Oriskany fossils, Yawger's woods, Union Springs	68
Fossils from the Clinton shales and limestones, Gasport	189
Fossils from the limestone lenticles at top of Clinton, Gasport	208
Fossils from the limestone lenticles in Clinton limestone, Lewiston	30
Fossils from Niagara shale, Middleport	225
The paleontologist. Fossils from Genesee shale and limestone, Canandaigua lake	20

Ruedemann, R. Graptolites from the various localities in Albany and Rensselaer co.	100
Van Ingen, G. and Ruedemann, R. Oriskany rocks and fossils near Kingston	1 500±
Fossils from the Chazy, Calciferous and Trenton limestones at Valcour, Grand isle and other points on Lake Champlain, 9 bbl.	3 000±
Luther, D. D. Fossils from the Agoniatites limestone, Manlius, N. Y.	50
Specimens of Paropsonema from the Portage sandstones, Naples	7
Ruedemann, R. and Sheehy, M. Graptolites from Hudson river shales at Mt Moreno near Hudson, N. Y.	2 000±
Prosser, C. S. Specimens from the Devonic of eastern-central New York. Mostly Ithaca beds. Collected while in service of the department 1895-97. Delivered June 1899	1 500±
Total by collection	9 234
Total accessions	10 865

APPENDIX 2

GENERAL RECORD OF LOCALITIES OF AMERICAN PALEOZOIC FOSSILS BELONGING TO STATE MUSEUM

ALPHABETIC LIST OF LOCALITIES

NEW YORK LOCALITIES ACCORDING TO COUNTIES

Albany co.

Albany
Albany rural cemetery
Clarksville
Coeymans Hollow
Cooksburg
Dormansville
Kenwood
Knox
Mud hollow
Peoria
Reidville
Thompson lake
Tivoli lake
Van Wie's point
West Berne

Allegany co.

Almond
Andover
Angelica
Bakers Bridge
Belmont
Belvidere
Elm Valley
Fillmore
Friendship
Hull's mills
Little Genesee
McHenry valley
Mills Mills
Moss creek
New Hudson
Nile
Phillipsburg [Belmont]

Allegany co. (*continued*)

Phillips Creek
Rockville
Scio
Scott's ravine
Vandermarks creek
Wellsville
Whitesville
Wiscoy
Wiscoy creek

Broome co.

Chenango Forks
Harpursville
Port Crane
Vestal

Cattaraugus co.

Allegany
Carrollton
Cattaraugus creek
Cold spring
Cold spring creek
Conewango
Dry creek
East Randolph
Elm creek
Fortville
Gowanda
Great Valley
Horse Corners
Ischua
Leon
Napoli
Napoli Center
New Albion

Cattaraugus co. *(continued)*

Olean
Portville
Randolph
Redhouse bridge
Rock City
Salamanca
Steamburg
Versailles
Wolf run

Cayuga co.

Auburn
Aurora
Carter's mills
Cayuga
Cayuga junction
Half Acre [Devil's half acre]
Hills Branch
Moravia
Sennett station
Springport
Union Springs

Chautauqua co.

Bell creek
Brockton
Canadaway creek
Cherrycreek
Dunkirk
Ellington
Forestville
Grant Station
Irving
Laona
Little Canadaway creek

Chautauqua co. *(continued)*

Miller's mill
Murder creek
Panama
Silvercreek
Terry's ravine
Walnut creek

Chemung co.

Chemung narrows
Elmira
Horseheads

Chenango co.

Bartlett's rocks
Bennett's creek
Bennettsville
Chenango river
Coventry [South Oxford]
Genegantslet creek
Greene
Mount Upton
New Berlin
North New Berlin
Norwich
Oxford
Sherburne creek
South New Berlin
Upper Corners
White Store

Clinton co.

Ausable Chasm
Beekmantown
Bluff point
Chazy
Cumberland head
East Beekmantown

Clinton co. (*continued*)

Plattsburg
Rouse Point
Valcour
Valcour island

Columbia co.

Becraft mountain
Hudson
Mount Moreno

Cortland co.

Cortland
Fall brook
Hait's gorge
Harford
Marathon

Delaware co.

East Davenport
Franklin
Hancock
Stamford

Dutchess co.

Stissing mountain

Erie co.

Alden
Angola
Big Buffalo creek
Big Sister creek
Black Rock
Buffalo
Clarence
Clarence hollow
East Elma
Eighteen Mile creek
Falkirk
Farnham creek

Erie co. (*continued*)

Hamburg-on-the-lake
Holland
North Evans
Pontiac
Springville
West Falls
Williamsville
Zoar

Essex co.

Essex
Keeseville
Port Henry
Westport

Fulton (?) co.

Cold spring

Genesee co.

Alexander
Batavia
Bethany
Buck run
Crooked creek
Darien
Darien Center
Griswold
Hill's gulch
Indian Falls
Leroy
Lime Rock
Pavilion
Pavilion Center
Stafford

Greene co.

Catskill
Catskill creek

Greene co. (*continued*)
- Gayhead
- Potuck creek
- South Cairo
- Urlton
- West Durham

Herkimer co.
- Dry lots
- Gravesville
- Jerusalem hill
- Litchfield
- Littlefalls
- Middleville
- Newport
- Poland
- Rathbun's creek
- Shed brook
- Stony brook
- West Canada creek
- White creek

Jefferson co.
- Black creek
- Sterlingville
- Watertown

Lewis co.
- Chimney point gulf
- Hubbard's creek
- Leyden
- Martinsburg
- Moose creek
- Sugar river
- Watson
- Whetstone creek

Livingston co.
- Avon
- Byersville
- Caledonia
- Cashaqua creek
- Dansville
- Fall brook
- Geneseo
- Jaycox run
- Littleville
- Livonia salt shaft
- Moscow
- Mount Morris
- North Lima
- Nunda
- West Avon
- York

Madison co.
- Cazenovia
- Chittenango
- Clockville
- Earlville
- Eaton
- Hamilton
- Leonardsville
- Morrisville

Monroe co.
- Erie canal
- Mumford
- Rochester

Montgomery co.
- Amsterdam
- Fonda
- Fort Plain
- Sprakers Basin
- Tribeshill

Niagara co.

- Gasport
- Lewiston
- Lockport
- Middleport

Oneida co.

- Alder creek
- Babcockhill
- Booneville
- Bridgewater
- Cassville
- Clinton
- Holland Patent
- New Hartford
- Paris hill
- Rome
- Tassel hill
- Trenton Falls
- Utica
- Waterville

Onondaga co.

- Appletree point
- Apulia
- Borodino
- Cardiff
- Delphi
- Delphi falls
- Dunks hill
- Fabius
- Jamesville
- Lafayette
- Manlius
- Malius square
- Marcellus
- Minoa
- Onondaga creek

Onondaga co. *(continued)*

- Onondaga Valley
- Pompey Hill
- Pratts falls
- Skaneateles
- Skaneateles Junction
- Spafford Corners
- Tinker's falls
- Tully

Ontario co.

- Bells gully
- Black point
- Blacksmith's gully
- Bristol
- Bristol Center
- Canadice
- Canandaigua
- Canandaigua lake
- Centerfield
- Clifton Springs
- Cromwell's creek
- East Bloomfield
- Fall brook
- Flint creek
- Geneva
- Hemlock creek
- High point
- Hopewell
- Ingleside
- Mertensia
- Mud creek
- Naples
- Orleans
- Phelps
- Phelps junction
- Riker hollow [Ingleside]

Ontario co. (*continued*)
- Seneca Castle
- Shortville
- Tannery gully
- Vincent
- West Bloomfield

Orange co.
- Monroe
- Nearpass quarry
- Port Jervis
- Prospect hill
- Rose point

Otsego co.
- Arnold's lake
- Bowe hill
- Cherry Valley
- Colliersville
- Cooperstown
- Coxs falls
- East Worcester
- Edson Corners
- Emmons
- Fall creek gorge
- Gilberts lake
- Gilbertsville
- Gowey pond
- Hartwick
- Hartwick Seminary
- Hinman hollow brook
- Laurens
- Maryland
- Milford
- Milford Center
- Morehouse brook
- Morris

Otsego co. (*continued*)
- Mount Vision
- New Lisbon
- Noblesville
- Oneonta
- Otego
- Otego creek
- Plainfield Center
- Richfield Springs
- Schenevus
- Springfield
- Susquehanna river
- Unadilla Forks
- Westford
- West Oneonta
- Westville
- Whitney brook
- Worcester

Rensselaer co.
- East Albany
- Rensselaer
- Rysedorf hill
- Sugar Loaf hill
- Troy

St Lawrence co.
- Potsdam
- Rossie

Saratoga co.
- Ballston
- Saratoga lake
- Saratoga Springs

Schenectady co.
- Pattersonville
- Schenectady

Schoharie co.

Adams hollow
Bear gulf
Blenheim
Breakabeen
Carlisle
Charlotteville
Cobleskill
Conesville
Delaware river
Eminence
Flat brook
Franklinton
Fultonham
Gilboa
Houston Corners
Jefferson
Kenhanagara creek
Lake brook
Lawyer's creek
Lawyersville
Leesville
Livingstonville
Mackey
Middle brook
Middleburg
Mill brook
North Blenheim
Panther creek
Richmondville
Schoharie
Schoharie creek
Sharon
Sharon Springs
Summit

Schoharie co. (*continued*)

Summit Corners
West Fulton
West Gilboa
West kill

Schuyler co.

Watkins

Seneca co.

Waterloo

Steuben co.

Addison
Adrian
Avoca
Bath
Brown hill
Cohocton
Cook's creek
Corning
Cotton hill
Erwin Center
Haskinville
Howard
Lent hill
Lindley
Morgan's creek
Norway ridge
Painted Post
Potter hill
Prattsburg
Wallace

Tioga co.

Nichols
Owego
Waverly

Tompkins co.

Cascadilla creek
Cayuta creek
Dryden
Ithaca
Ludlowville
Ludlowville creek

Ulster co.

Bristol hill church
Kingston
Marbletown
Mt Marion station
Plaate kill
Wawarsing
West Hurley
Westpark
Wilbur tunnel

Washington co.

Bakers falls
Sandyhill
Skeen mountain
Smiths
Smiths Basin
Whitehall

Wyoming co.

Attica
Cayuga creek
Cowlesville
East Koy creek
Fall brook ravine
Folsomdale
Gibson's glen
Java Village
Johnsons falls
North Java
Peoria
Pike
Portageville
Stony brook
Strykersville
Varysburg
Warsaw
Westside ravine
Wolf creek

Yates co.

Bellona
Benton run
Cashong creek
Dresden
Penn Yan
Richmond's quarry
Rock Stream

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St Louis beds, 1972

Barren coal-measures, 2000

Coal-measures, 665, 2003, 2004, 2005, 2006, 2007, 2012

Cretaceous, 845

COPY OF OLD LIST OF LOCALITIES OUTSIDE STATE OF NEW YORK

Specimens bearing round tickets

These localities have been incorporated in the general catalogue without removal of ticket.

157 Clinton beds. Hamilton, Ontario, Can. C. D. Walcott, collector. 1878.

180 Niagara shale. Waldron, Shelby co., Ind. C. D. Walcott and C. Van Deloo, collectors. 1878.

181 Niagara limestone. Charlestown, Clarke co., Ind. C. D. Walcott, collector. 1878.

182 Niagara limestone. Flatrock creek, Shelby co., Ind. C. D. Walcott, collector. 1878.

183 Niagara limestone. Hamilton, Ontario, Can. C. D. Walcott, collector. 1878.

255 Schoharie grit. Pendleton, Madison co., Ind. C. D. Walcott and C. Van Deloo, collectors. 1878.

278 Onondaga limestone. Charlestown, Clark co., Ind. C. D. Walcott and C. Van Deloo, collectors.

278a Onondaga limestone. Lexington, Scott co., Ind. C. D. Walcott and C. Van Deloo, collectors.

279 Onondaga limestone. Falls of the Ohio. From Sidney Lyon.

279a Onondaga limestone. Falls of the Ohio. C. D. Walcott, collector. 1877.

280 Onondaga limestone. South Walpole, 4th con., lot 14, Ontario, Can. C. D. Walcott, collector. 1878.

281 Onondaga limestone. North Walpole, 13th con., lot 5, Ontario, Can. C. D. Walcott, collector. 1878.

282 Onondaga limestone. South Cayuga, 4th con., lots 30 and 32, Ontario, Can. C. D. Walcott, collector. 1878.

283 Onondaga limestone. Pt Colborne and Wainfleet, 1st and 2d con., Ontario, Can. C. D. Walcott, collector. 1878.

284 Onondaga limestone. Kelly's Island and on Pt Marblehead opposite, O. C. D. Walcott, collector. 1878.

300 Hamilton beds. Falls of the Ohio and southern Ind. Sidney Lyon.

301 Hamilton beds. Lexington, Scott co., Ind. C. D. Walcott and C. Van Deloo, collectors. 1878.

324 Hamilton beds. Just beneath the black slate (Genesee) Lexington, Scott co., Ind. C. D. Walcott, collector.

324a Hamilton beds? Beneath the waterlime. Lexington, Scott co., Ind. C. D. Walcott, collector.

326 New Albany black slate (=Genesee slate of New York) Lexington, Scott co., Int. C. D. Walcott and C. Van Deloo, collectors.

350 Lower Carbonic. Crawfordsville, Ind. C. D. Walcott, collector. 1877.

RECORD OF LOCALITIES

1 Hamilton beds. One mile south of Leonardsville, Madison co., in bluff on the west side of the plank road, 370 to 400 feet above the Marcellus shale. F. B. Meek, R. P. Whitfield and C. Van Deloo, collectors. 1857.

2 Marcellus shale. One and a half miles south of Bridgewater, at the side of plank road and in bed of brook. F. B. Meek, R. P. Whitfield and C. Van Deloo, collectors. 1857.

3 Hamilton beds. Top of the bluff east of Unadilla Forks, Otsego co., about 320 feet above Marcellus shale. F. B. Meek, R. P. Whitfield and C. Van Deloo, collectors. 1857.

4 Hamilton beds. In the bluff east of Unadilla Forks, Otsego co., 250 to 330 feet above Marcellus shale. F. B. Meek, R. P. Whitfield and C. Van Deloo, collectors. 1857.

5 Hamilton beds. Bluff one mile south of Plainfield Center, Otsego co., 300 to 320 feet above Marcellus shale. F. B. Meek, R. P. Whitfield and C. Van Deloo, collectors. 1857.

5– means 555, which see.

6 Hamilton beds. Quarry up the ravine, west of Leonardsville, Madison co., about 320 feet above the Marcellus shale near the top of no. 3 of section at Unadilla Forks. F. B. Meek, R. P. Whitfield and C. Van Deloo, collectors. 1857.

6½ Hamilton beds. Locality same as number 6. Position, blue shales, no. 5 of section at Unadilla Forks (resting on no. 3). F. B. Meek, R. P. Whitfield and C. Van Deloo, collectors. 1857.

7 Hamilton beds. Found loose in the neighborhood of Unadilla Forks, Otsego co., on the Madison co. side of the river. F. B. Meek, R. P. Whitfield and C. Van Deloo, collectors. 1857.

8 Hamilton beds. Three miles south of Unadilla Forks. Position lower Hamilton. (Found loose and in detached masses.) F. B. Meek, R. P. Whitfield and C. Van Deloo, collectors. 1857.

9 Hamilton beds. Presented in part by John B. Wells and others; collected in the neighborhood of Unadilla Forks, Otsego co. F. B. Meek, R. P. Whitfield and C. Van Deloo, collectors. 1857.

10 Hamilton beds. From a ledge one half mile south of Leonardsville, Madison co., 370 to 430 feet above the Marcellus shale; no. 6 of section at Unadilla Forks. F. B. Meek, R. P. Whitfield and C. Van Deloo, collectors. 1857.

11 Hamilton beds. From bank of brook one mile south of Unadilla Forks, on east side of river. Blue shale, no. 2 of section at Unadilla Forks (resting on Marcellus shale ?). F. B. Meek, R. P. Whitfield and C. Van Deloo, collectors. 1857.

12 Hamilton beds. One mile south of Leonardsville, Madison co. In quarry on west side of the plank road; no. 4 of section at Unadilla Forks, about 320 feet above the Marcellus shale. F. B. Meek, R. P. Whitfield and C. Van Deloo, collectors. 1857.

13 Hamilton beds. Opposite Leonardsville, Madison co., on east side of Unadilla river. Position, lower part of no. 3 of section at Unadilla Forks; about 250 feet above the Marcellus shale. F. B. Meek, R. P. Whitfield and C. Van Deloo, collectors. 1857.

14 Hamilton beds. From the top of the falls three miles southwest of Leonardsville, Madison co., about 430 feet above the Marcellus shale; no. 7 of section at Unadilla Forks. F. B. Meek, R. P. Whitfield and C. Van Deloo, collectors. 1857.

15 Hamilton beds. In the bed of the stream about 100 yards below the falls, three miles southwest of Leonardsville, Madison co., no. 5 of section; about 370 feet above the Marcellus shale. F. B. Meek, R. P. Whitfield and C. Van Deloo, collectors. 1857.

16 Hamilton beds. From a ledge one and one half miles southwest of Leonardsville. Position about 540 feet above the Marcellus shale; no. 10 of section at Unadilla Forks. F. B. Meek, R. P. Whitfield and C. Van Deloo, collectors. 1857.

17 Hamilton beds. From two to two and one half miles southwest of Leonardsville, Madison co. Position no. 8 of section at Unadilla Forks; about 434 feet above the Marcellus shale. F. B. Meek, R. P. Whitfield and C. Van Deloo, collectors. 1857.

17½ Position same as 17. Locality, upper part of ravine, top of cliff (below the falls), three miles southwest of Leonardsville, Madison co. F. B. Meek, R. P. Whitfield and C. Van Deloo, collectors. 1857.

18 Hamilton beds. Found loose about two and one half miles southwest of Leonardsville, Madison co. F. B. Meek, R. P. Whitfield and C. Van Deloo, collectors. 1857.

19 Hamilton beds. One and one half miles southwest of Leonardsville, Madison co. Position no. 6 of section; about 420 feet above the Marcellus shale. F. B. Meek, R. P. Whitfield and C. Van Deloo, collectors. 1857.

20 Hamilton beds. Presented by Dr Crandall of Leonardsville, Madison co. Other specimens with the same number were collected in the neighborhood by F. B. Meek, R. P. Whitfield and C. Van Deloo. 1857.

21 Fragments collected on the road between Bridgewater and Unadilla Forks. Some Hamilton and some Onondaga fossils. F. B. Meek, R. P. Whitfield and C. Van Deloo, collectors. 1857.

22 Pentamerus (Coeymans) limestone. Schoharie. F. B. Meek, R. P. Whitfield and C. Van Deloo, collectors. 1857.

23 Delthyris shaly (New Scotland) limestone. Schoharie. F. B. Meek, R. P. Whitfield and C. Van Deloo, collectors. 1857.

24 Tentaculite (Manlius) limestone. Schoharie. F. B. Meek, R. P. Whitfield and C. Van Deloo, collectors. 1857.

25 Oriskany sandstone; loose mass. Schoharie. F. B. Meek, R. P. Whitfield and C. Van Deloo, collectors. 1857.

26 Hamilton beds. Near the top of a cliff, east of Middleburg, Schoharie co. Estimated hight about 300 feet above Schoharie creek. W. M. Gabb, collector. 1857.

27 Schoharie grit. From a stone wall one half mile east of Middleburg, Schoharie co. W. M. Gabb, collector. 1857.

28 From a boulder in Schoharie creek, three fourths of a mile east of Fultonham, Schoharie co. W. M. Gabb, collector. 1857.

29 Hamilton beds. One and one half miles southwest of Fultonham, Schoharie co., about 250 feet above the level of Schoharie creek. W. M. Gabb, collector. 1857.

30 Hamilton beds. One and one half miles southwest of Fultonham; about 270 feet above the level of Schoharie creek. W. M. Gabb, collector. 1857.

31 Hamilton beds. One mile east of Fultonham. From loose masses which had fallen from the ledge above. W. M. Gabb, collector. 1857.

32 Hamilton beds. Four miles northeast of Middleburg; loose masses on the hill. W. M. Gabb, collector. 1857.

33 Hamilton beds. Base of hill two miles south of Fultonham; in bank of small stream. W. M. Gabb, collector. 1857.

34 Hamilton beds. One mile south of Fultonham, about 25 feet above level of Schoharie creek, east side. W. M. Gabb, collector. 1857.

35 Hamilton beds. Boulders from a small stream one mile south of Fultonham. W. M. Gabb, collector. 1857.

36 From boulders in Schoharie creek. One mile south of Fultonham. W. M. Gabb, collector. 1857.

37 Hamilton beds. Found loose in a branch of Schoharie creek, two and one half miles south of Fultonham. W. M. Gabb, collector. 1857.

38 Hamilton beds. From above the falls one and one half miles west of Fultonham. W. M. Gabb, collector. 1857.

39 Hamilton beds. From below the falls one and one half miles west of Fultonham. W. M. Gabb, collector. 1857.

40 Hamilton beds. One half mile west of Fultonham; about 60 feet above the level of Schoharie creek. W. M. Gabb, collector. 1857.

41 Hamilton beds. One mile south of Fultonham; about 10 feet above the water level on west side of creek. W. M. Gabb, collector. 1857.

42 Hamilton beds. Boulder, one half-mile south of Fultonham, in Schoharie creek. W. M. Gabb, collector. 1857.

43 Hamilton beds. Two and one half miles south of Fultonham; 100 feet west of the falls. W. M. Gabb, collector. 1857.

44 Hamilton beds. On Skaneateles lake, near Spafford Corners, at the level of the lake. W. M. Gabb, collector. 1857.

45 Hamilton beds. Skaneateles lake, one mile north of Spafford Corners. Elevation from 40 to 50 feet above the level of the lake. W. M. Gabb, collector. 1857.

46 Marcellus shale. Three miles southeast of Skaneateles village, at water level. W. M. Gabb, collector. 1857.

47 Hamilton beds. Ravine at Spafford Corners; 300 feet above the level of Skaneateles lake. W. M. Gabb, collector. 1857.

48 Hamilton beds. Skaneateles lake, one mile north of Spafford Corners. Elevation varying from 10 to 40 feet. W. M. Gabb, collector. 1857.

49 Hamilton beds. Loose mass, one mile south of Borodino, near Skaneateles lake. W. M. Gabb, collector. 1857.

50 Oriskany sandstone. Quarry one half mile southeast of Skaneateles Junction. W. M. Gabb, collector. 1857.

51 Limestone underlying Oriskany sandstone at quarry one half mile southeast of Skaneateles Junction. W. M. Gabb, collector. 1857.

52 Limestone. About 15 feet above the level of creek; one half mile north of Marcellus village. W. M. Gabb, collector. 1857.

53 Limestone. Found loose one half mile south of Skaneateles Junction. W. M. Gabb, collector. 1857.

54 Limestone. Quarry one mile south of Skaneateles Junction. W. M. Gabb, collector. 1857.

55 Hamilton beds. Found loose four miles south of Skaneateles village. W. M. Gabb, collector. 1857.

56 Hamilton beds. Ravine one mile north of Spafford Corners, Skaneateles lake. W. M. Gabb, collector. 1857.

57 Hamilton beds. Loose rocks from various localities. W. M. Gabb, collector. 1857.

58 Salina beds. Gypsum. One and one half miles north of Marcellus village. Onondaga co. W. M. Gabb, collector. 1857.

59 Salina beds. Presented by W. Emmons of Borodino, Onondaga co. Others having the same number collected by W. M. Gabb. 1857.

60 Hamilton beds. From the base of the hill composed of this group at the north side of Cumberland, Md. R. P. Whitfield and C. Van Deloo, collectors. 1858.

61 Hamilton beds. Mostly loose fragments which have been plowed up from the underlying rocks at the summit of the hill north of Cumberland, Md. R. P. Whitfield and C. Van Deloo, collectors. 1858.

62 Hamilton beds. From the shales of this group exposed a few rods north of the dwelling-house on Mr Howe's farm, three miles south of Paterson's creek station, which is eight miles east of Cumberland, Md. This locality is in Virginia, three miles from the Potomac river. R. P. Whitfield and C. Van Deloo, collectors. 1858.

63 ?(Probably Chemung). These fossils are from the rocks about halfway between Newcreek (=Keyser and Piedmont stations), W. Va., close to the railroad, or 26 miles west of Cumberland, Md., and are known as "Old red sandstone." R. P. Whitfield and C. Van Deloo, collectors. 1858.

64 Hamilton beds. Canandaigua lake shore, from one to one and a half miles below Menteth's point landing. R. P. Whitfield and J. W. Hall, collectors. 1858.

65 Hamilton beds. Specimens from the rocks about half a mile below the landing at Menteth's point, Canandaigua lake shore. R. P. Whitfield and J. W. Hall, collectors. 1858.

66 Hamilton beds. Specimens from the rocks between half a mile and a mile below the landing at Menteth's point, Canandaigua lake shore. R. P. Whitfield and J. W. Hall, collectors. 1858.

67 Hamilton beds. Specimens collected in the ravine, near Menteth's house, at and above the dam. Menteth's point, Canandaigua lake. R. P. Whitfield and J. W. Hall, collectors. 1858.

68 Hamilton beds. Specimens collected in the ravine, near Menteth's house, Menteth's point, Canandaigua lake. R. P. Whitfield and J. W. Hall, collectors. 1858.

69 Hamilton beds. Specimens collected from the rocks forming the falls in the ravine above Menteth's house, about one and a half miles back from the lake shore, Canandaigua lake. R. P. Whitfield and J. W. Hall, collectors. 1858.

70 Hamilton beds. Specimens collected from the Chonetes-bed, at or near the level of the lake, in front of Mr Gelder's house, one mile above Menteth's, Canandaigua lake shore. R. P. Whitfield and J. W. Hall, collectors. 1858.

71 Hamilton beds. Specimens collected a little below Black point, three miles above Menteth's point, Canandaigua lake. A few of the specimens marked with this number are from the east side of the lake, opposite Black point, in a similar position. R. P. Whitfield and J. W. Hall, collectors. 1858.

72 Hamilton beds. Specimens collected in the small ravine which passes from Mr Gelder's house to the lake shore, from 10 to 15 feet above the water level. Canandaigua lake. R. P. Whitfield and J. W. Hall, collectors. 1858.

73 Hamilton beds. Specimens collected half a mile below Black point, Canandaigua lake. R. P. Whitfield and J. W. Hall, collectors. 1858.

74 Hamilton beds. Crinoids from North Bristol, Ontario co., on land of Mr Sisson; found in the bed of the stream. C. A. White and C. Van Deloo, collectors. 1860.

75 Hamilton beds. Crinoids from Fall brook, one and one half miles north of Geneseo, Livingston co., in the bed of the stream on the north side of the ravine, and on the same level as the track of the Genesee valley railroad. C. A. White and C. Van Deloo, collectors. 1860.

76 Hamilton beds. Crinoids from the west shore of Canandaigua lake. All the specimens (with two or three exceptions) were collected along the lake shore where the shale is exposed, from below the water level to 6 or 8 feet above it, and north of Menteth's point. The exceptions are from a similar position above the lake, south

of Menteth's point. C. A. White and C. Van Deloo, collectors. 1860.

77 Hamilton beds. Crinoids from calcareous shales near the railroad station, Geneseo. C. A. White and C. Van Deloo, collectors. 1860.

78 Hamilton beds. Crinoids from York, Livingston co., and its vicinity. C. A. White and C. Van Deloo, collectors. 1860.

79 Hamilton beds. Specimens collected from ravines coming into Mud creek in the vicinity of Muttonville (=Vincent), North Bristol township, Ontario co. C. A. White and C. Van Deloo, collectors. 1860.

80 Hamilton beds. Specimens collected at and in the vicinity of Geneseo. C. A. White and C. Van Deloo, collectors. 1860.

81 Hamilton beds. Specimens collected near Moscow, Livingston co. C. A. White and C. Van Deloo, collectors. 1860.

82 Hamilton beds. Specimens collected at and in the vicinity of York. C. A. White and C. Van Deloo, collectors. 1860.

83 Hamilton beds. Specimens collected from a bank of shale on the east side of the creek above the mill, about two miles south of Pavilion, Genesee co. C. A. White and C. Van Deloo, collectors. 1860.

84 Hamilton beds. Specimens collected from a shallow ravine on the east side of the road between Pavilion village and Pavilion Center, about one mile north of Pavilion village. C. A. White and C. Van Deloo, collectors. 1860.

85 Hamilton beds. Specimens collected at and in the vicinity of Bethany, Genesee co. C. A. White and C. Van Deloo, collectors. 1860.

86 Hamilton beds. Specimens collected at Eighteen Mile creek, Erie co. C. A. White, collector, 1860; and C. Van Deloo, collector, 1864.

87 Hamilton beds. Specimens collected at and in the vicinity of "Hamburg-on-the-lake", Erie co. C. A. White, collector, 1860; and C. Van Deloo, collector, 1864.

88 Marcellus shale. (Some specimens of Corniferous limestone.) Specimens collected at Littleville near West Avon. C. A. White and C. Van Deloo, collectors. 1860.

89 Marcellus shale. Specimens collected in a ravine about two miles west of Alden, Erie co. C. A. White and C. Van Deloo, collectors. 1860.

90 Hamilton beds. Specimens collected on Hemlock creek, Richmond township, Ontario co. C. A. White and C. Van Deloo, collectors. 1860.

91 Hamilton beds. Specimens collected at and in the vicinity of Menteth's point, along the west shore of Canandaigua lake, Ontario co. C. A. White and C. Van Deloo, collectors. 1860.

92 Hamilton beds. Specimens collected in the vicinity of Darien Center and Darien, Genesee co. C. A. White, collector, 1860; and C. Van Deloo, collector, 1864.

93 Hamilton beds. Specimens collected in a ravine about three fourths of a mile south of Alexander, Genesee co. C. A. White and C. Van Deloo, collectors. 1860.

94 Hamilton beds. Specimens collected in the vicinity of Dresden, Yates co. C. A. White and C. Van Deloo, collectors. 1860.

95 Hamilton beds. Specimens collected on Cashong creek, near Bellona, Yates co. C. A. White and C. Van Deloo, collectors. 1860.

96 Hamilton beds. Specimens collected on Benton run, three miles north of Bellona. C. A. White and C. Van Deloo, collectors. 1860.

97 Hamilton beds. Specimens collected on Cromwell's creek, four miles south of Geneva. C. A. White and C. Van Deloo, collectors. 1860.

98 Tully limestone. Specimens collected at Bellona. C. A. White and C. Van Deloo, collectors. 1860.

99 Tully limestone. Specimens collected near Dresden. C. A. White and C. Van Deloo, collectors. 1860.

100 Hamilton beds. Crinoids. Specimens collected at Cashong creek, near Bellona. C. A. White and C. Van Deloo, collectors. 1860.

101 Hamilton beds. Crinoids. Specimens collected at Benton run, three miles north of Bellont. C. A. White and C. Van Deloo, collectors. 1860.

102 Hamilton beds. Crinoids. Collected near Dresden. C. A. White and C. Van Deloo, collectors. 1860.

103 Hamilton beds. Specimens found in the road in the extreme southern part of, and at Gates mill in West Bloomfield. C. A. White and C. Van Deloo, collectors. 1860.

104 Onondaga limestone. Clarence hollow. R. P. Whitfield, C. A. White and C. Van Deloo, collectors. 1860.

105 Onondaga limestone. From loose pieces of rock on Schultz's farm, three miles west of Clarence hollow. R. P. Whitfield, C. A. White and C. Van Deloo, collectors. 1860.

106 Onondaga limestone. Specimens from a limestone quarry and limekiln, one mile west of Clarence hollow. R. P. Whitfield, C. A. White and C. Van Deloo, collectors. 1860.

107 Onondaga limestone. From quarries on Mr Young's farm near Williamsville. R. P. Whitfield, C. A. White and C. Van Deloo, collectors. 1860.

108 Onondaga limestone. Beds near plaster mill, Williamsville. R. P. Whitfield, C. A. White and C. Van Deloo, collectors. 1860.

109 Waterlime beds at Williamsville. R. P. Whitfield, C. A. White and C. Van Deloo, collectors. 1860.

110 Waverly beds (Chemung group, old record). Specimens from Richfield, Summit co., O. Go north from Richfield center (east village), about half a mile, turn to the left, cross the fields a few hundred yards into the bed of a small stream. C. A. White, collector. 1861.

111 Waverly beds (Chemung group, old record). Specimens from Whetstone creek, near the village of Bridgeport, town of Canaan, Wayne co., O. C. A. White, collector. 1861.

112 Waverly beds (Chemung group, old record). Specimens from Mallets creek, about two miles north of the village of York Center, Medina co., O. C. A. White, collector. 1861.

113 Waverly beds (Chemung group, old record). Specimens from Medina, Medina co., O. Go down the creek about half a mile southeast of village. C. A. White, collector. 1861.

114 Waverly beds (Chemung group, old record). Specimens collected at Lodi, town of Harrisville, Medina co., O. Go up the creek from the village and examine the shales and flagstones for the distance of a mile and a half. C. A. White, collector. 1861.

115 Waverly beds (Chemung group, old record). Specimens collected at Chatham Center, Medina co., O., along the bed of the creek, about a quarter of a mile southeast of village. C. A. White, collector. 1861.

116 Waverly beds (Chemung group, old record). Specimens from the east bank of the creek, near the water's edge, about a mile northwest of the village of Warren, Trumbull co., O. C. A. White, collector. 1861.

117 Waverly beds (Chemung group, old record). Specimens collected at Bagdad, one and one half miles southwestward from Weymouth, Medina co., O. C. A. White, collector. 1861.

118 Waverly beds (Chemung group, old record). Specimens collected near Titusville, from loose masses in the valley of Oil creek, Venango co., Pa. C. A. White, collector. 1861.

119 Waverly beds (Chemung group, old record). Specimens collected at Meadville, Crawford co., Pa., about a mile westward from the center of the village, about halfway

up the hill on the north side of the creek. C. A. White, collector. 1861.

120 Waverly beds (Chemung group, old record). Specimens collected at Abbeyville, Medina co., O. C. A. White, collector. 1861.

121 Waverly beds (Chemung group, old record). Specimens collected at Akron, Summit co., O. C. A. White, collector. 1861.

122 Waverly beds (Chemung group, old record). Specimens from Cuyahoga Falls, Summit co., O. C. A. White, collector. 1861.

123 Waverly beds (Chemung group, old record). Specimens found loose at Franklin, Venango co., Pa. C. A. White, collector. 1861.

124 Waverly beds (Chemung group, old record). Specimens from the town of Penfield, three miles west of Litchfield, in Lorain co., O. C. A. White, collector. 1861.

125 Waverly beds (Chemung group, old record). Specimens from the Cauda-galli bed, one and one half miles south of Liverpool, Medina co., O. C. A. White, collector. 1861.

126 Waverly beds. Found in the drift at Medina, O. C. A. White, collector. 1861.

127 Marcellus shale. Castleton, Ontario co., five miles west of Geneva. C. A. White, collector. 1861.

128 Marcellus shale. Specimens from Flint creek, a little below Orleans, in the town of Phelps, Ontario co. C. A. White, collector. 1861.

129 Agoniatites limestone (Goniatite limestone, old record). Cherry Valley. C. A. White, collector. 1860 and 1861.

130 Agoniatites limestone (Goniatite limestone, old record). Marcellus. C. A. White, collector. 1860 and 1861.

131 Agoniatites limestone (Goniatite limestone, old record). Two miles west of Manlius square, Onondaga co. C. A. White, collector. 1860 and 1861.

132 Onondaga limestone. Black Rock. C. A. White, collector. 1860 and 1861.

133 Onondaga limestone (Upper Helderberg limestone, old record). Specimens collected at Warner's quarry, four miles northwest of LeRoy. C. A. White, collector. 1860 and 1861.

134 Onondaga limestone (Upper Helderberg limestone, old record). Specimens collected near (north of) LeRoy. C. A. White, collector. 1860 and 1861.

135 Onondaga limestone (Upper Helderberg limestone, old record). Specimens collected near Caledonia. C. A. White, collector. 1860 and 1861.

136 Onondaga limestone (Upper Helderberg limestone, old record). Specimens collected at Cherry Valley. C. A. White, collector. 1860 and 1861.

137 Onondaga limestone (Upper Helderberg limestone, old record). Specimens from Eastman's quarry, three miles north of Waterville. C. A, White, collector. 1860 and 1861.

138 Onondaga limestone (Upper Helderberg limestone, old record). Specimens from an exposure near the road, in a small creek, two miles northeast from Waterville. C. A. White, collector. 1860 and 1861.

139 Onondaga limestone (Upper Helderberg limestone, old record). Specimens collected from Babcock hill, Bridgewater, Oneida co. C. A. White, collector. 1860 and 1861.

140 Onondaga limestone (Upper Helderberg limestone, old record). Specimens from north of Batavia. C. A. White, collector. 1860 and 1861.

141 Onondaga limestone (Upper Helderberg limestone, old record). Specimens collected at Onondaga Valley. C. A. White, collector. 1860 and 1861.

142 Onondaga limestone (Upper Helderberg limestone, old record). Specimens collected at Williamsville. C. A. White, collector. 1860 and 1861.

143 Onondaga limestone (Upper Helderberg limestone, old record). Akron. C. A. White, collector. 1860 and 1861.

144 Onondaga limestone (Upper Helderberg limestone, old record). Clarence hollow. C. A. White, collector. 1860 and 1861.

145 Onondaga limestone (Upper Helderberg limestone, old record). Two miles west of Manlius square. C. A. White, collector. 1860 and 1861.

146 Onondaga limestone (Upper Helderberg limestone, old record). Stafford. C. A. White, collector. 1860 and 1861.

147 Onondaga limestone (Upper Helderberg limestone, old record). Shortsville near Manchester, and seven miles northward from Canandaigua. C. A. White, collector. 1860 and 1861.

148 Hamilton beds. Specimens from Tassel hill, three miles east of Waterville. C. A. White, collector. 1860 and 1861.

149 Lower Marcellus shale. Marcellus. C. A. White, collector. 1860 and 1861.

150 Onondaga limestone (Upper Helderberg limestone, old record). Cassville, Oneida co. C. A. White, collector. 1860 and 1861.

151 Onondaga limestone (Upper Helderberg limestone, old record). Specimens from one mile east of Jamesville, Onondaga co. C. A. White, collector. 1860 and 1861.

152 Lower Marcellus shale. Two and a half miles west of Manlius square. C. A. White, collector. 1860 and 1861.

153 Onondaga limestone (Upper Helderberg, etc., old record). Specimens collected from walls at "Dry lots," Herkimer co. C. A. White, collector. 1860 and 1861.

154 Onondaga limestone (Upper Helderberg limestone, old record). Specimens from one mile east of Babcock hill, Bridgewater. C. A. White, collector. 1860 and 1861.

155 Helderbergian. Specimens from the upper beds at Jerusalem hill. No. 5 of section no. 1 of Jerusalem hill. C. A. White, collector. 1860 and 1861.

156 Helderbergian. Jerusalem hill. From no. 3 of section no. 1. C. A. White, collector. 1860 and 1861.

157 Helderbergian. Jerusalem hill. From no. 5 of section no. 2. C. A. White, collector. 1860 and 1861.

158 Helderbergian. Jerusalem hill. From no. 7 of section no. 2. C. A. White, collector. 1860 and 1861.

159 Helderbergian. Jerusalem hill. From no. 9 of section no. 2. C. A. White, collector. 1860 and 1861.

160 Helderbergian. One mile east of Sennett station, N. Y. C. railroad. C. A. White, collector. 1860 and 1861.

161 Helderbergian. From Rockville near Sharon Springs. C. A. White, collector. 1860 and 1861.

162 Helderbergian. Paris hill, Oneida co. C. A. White, collector. 1860 and 1861.

163 Helderbergian. From Leesville, three miles west of Sharon Springs. C. A. White, collector. 1860 and 1861.

164 Helderbergian. Cherry Valley. From the upper part of no. 3 of Cherry Valley section. C. A. White, collector. 1860 and 1861.

165 Helderbergian. Cherry Valley. From the lower part of no. 3 of Cherry Valley section. C. A. White, collector. 1860 and 1861.

166 Waterlime? From no. 1 of section. Four miles south of Cayuga village. C. A. White, collector. 1860 and 1861.

167 Helderbergian. From no. 2 of section. Four miles south of Cayuga village. C. A. White, collector. 1860 and 1861.

168 Oriskany sandstone? Cherry Valley. No. 4 of Cherry Valley section. C. A. White, collector. 1860 and 1861.

168 Onondaga limestone (Upper Helderberg limestone, old record). Springport on Cayuga lake. C. A. White, collector. 1860 and 1861.

No. 168 is repeated by an oversight. The character of the fossils however is such that they can be readily distinguished.

169 Lower Marcellus shale. Cherry valley. C. A. White, collector. 1860 and 1861. (Specimens with number doubly underscored collected in 1864 by C. Van Deloo)

170 Onondaga limestone (Upper Helderberg limestone, old record). Specimens from quarries about three miles northeast of Buffalo. C. A. White, collector. 1860 and 1861.

171 Onondaga limestone (Upper Helderberg limestone, old record). Waterloo. C. A. White, collector. 1860 and 1861.

172 Waterlime. Two and one half miles southeast of Cayuga village. C. A. White, collector. 1860 and 1861.

173 Marcellus shale. From the bed of Flint creek, four and one half miles southeast from Clifton Springs. C. A. White, collector. 1860 and 1861.

174 Hamilton shale. Near Ludlowville. C. A. White, collector. 1860 and 1861.

175 Hamilton shale. From the east bank of Cayuga lake, three miles south of Ogdens ferry. C. A. White, collector. 1860 and 1861.

176 Hamilton shale. From the east landing of Ogdens or Kidders ferry, Cayuga lake. C. A. White, collector. 1860 and 1861.

177 Oriskany sandstone. Four miles southwest of Auburn on land of Mr Baker. Including specimens of Favosites which are from the Onondaga limestone. C. A. White, collector. 1860 and 1861.

178 Onondaga limestone (Upper Helderberg limestone, old record). From Gidding's quarries, three miles north of Canandaigua. C. A. White, collector. 1860 and 1861.

179 Onondaga limestone (Upper Helderberg limestone, old record). From North Lima, two miles westward from Honeoye Falls. C. A. White, collector. 1860 and 1861.

180 Hamilton shale. Three and a half miles south of Castleton, on Flint creek. Ontario co. James Hall and others, collectors. 1860 and 1861.

181 Onondaga limestone (Upper Helderberg limestone, old record). Fish remains, etc., near Clifton Springs. C. A. White, collector. 1861.

182 Schoharie grit. Specimens collected in the neighborhood of Clarksville, Albany co. R. P. Whitfield and C. Van Deloo, collectors. 1861.

183 Schoharie grit. Near Clarksville. C. Van Deloo, collector. 1862.

184 Schoharie grit. Collected in the town of Knox, Albany co. C. Van Deloo, collector. 1862.

185 Onondaga limestone. Collected at the patent limekiln near Clarksville. C. Van Deloo, collector. 1862.

186 Schoharie grit. Schoharie. C. Van Deloo, collector. 1862.

187 Genesee slate. From Crooked creek near Darien. C. Van Deloo, collector. 1864.

188 Hamilton beds. Hill southwest of Schoharie. C. Van Deloo, collector. 1862.

189 Helderbergian. Schoharie. C. Van Deloo, collector. 1862.

190 Hamilton beds. Specimens collected from a thin band of dark shale just at the base of the falls in the ravine at the south line of Mr Gelder's farm, Canandaigua lake. R. P. Whitfield and C. Van Deloo, collectors. 1862.

191 Hamilton beds. Specimens collected along the west shore of Canandaigua lake and in the adjacent ravines. R. P. Whitfield and C. Van Deloo, collectors. 1862.

192 Hamilton beds. Collected in the ravines in the neighborhood of Vincent (Muttonville). R. P. Whitfield and C. Van Deloo, collectors. 1862.

193 Portage beds. From a ravine terminating at the village of Bristol Center, Ontario co. Specimens collected near the base of the group. R. P. Whitfield and C. Van Deloo, collectors. 1862.

194 Genesee slate. From the ravine at Bristol Center. Within a few feet of the top of the group. R. P. Whitfield and C. Van Deloo, collectors. 1862.

195 Portage beds. Fossil plants from the black bands of shale in ravine at Bristol Center. The bands possessing the character of Genesee slate. R. P. Whitfield and C. Van Deloo, collectors. 1862.

196 Hamilton beds. From a ravine bearing the name of "Bear gulf," about two and a half miles north of Summit Corners, Schoharie co. C. Van Deloo, collector. 1862.

197 Hamilton beds. Collected from loose masses in the vicinity of Apulia, Onondaga co. R. P. Whitfield and George B. Simpson, collectors. 1863.

198 Hamilton beds. Specimens collected at the base of a small waterfall on the creek at the crossing of the road running north from Tully village (two miles). The Tully limestone forms the top of the falls, the Hamilton shales the base. R. P. Whitfield and George B. Simpson, collectors. 1863.

199 Tully limestone. From the limestone layers at the top of the formation as seen at Tinkers falls, Onondaga co. R. P. Whitfield and George B. Simpson, collectors. 1863.

200 Hamilton beds. Specimens collected from stream one quarter mile east of the village of Moravia. George B. Simpson, collector. 1863.

201 Hamilton beds. Specimens collected from Dry creek, three quarters of a mile south of village of Moravia. George B. Simpson, collector. 1863.

202 Hamilton beds. Specimens collected from masses of rock at base of Pratts falls, Pompey Hill. George B. Simpson, collector. 1863.

203 Hamilton beds. Specimens collected from loose pieces one mile north of village of Pompey Hill. George B. Simpson, collector. 1863.

204 Chemung beds. Three miles west of East Randolph, township of Conewango, Cattaraugus co. C. Van Deloo, collector. 1863.

205 Chemung beds. Specimens collected near East Randolph, Cattaraugus co. C. Van Deloo, collector. 1863.

206 Chemung beds. Near town line, between Napoli and Conewango. C. Van Deloo, collector. 1863.

207 Chemung beds. Town line between Napoli and Cold Spring, near East Randolph. C. Van Deloo, collector. 1863.

208 Chemung beds. Elm creek, town of Conewango, Cattaraugus co. C. Van Deloo, collector. 1863.

209 Chemung beds. New Albion, Cattaraugus co. C. Van Deloo, collector. 1863.

210 Chemung beds. Cold Spring creek at Napoli Center. C. Van Deloo, collector. 1863.

211 Chemung beds. Cold Spring creek, town of Napoli, three quarters of a mile north of Cold Spring, Cattaraugus co. C. Van Deloo, collector. 1863.

212 Chemung beds. Dry creek, Conewango, Cattaraugus co. C. Van Deloo, collector. 1863.

213 Chemung beds. Cold Spring, Cattaraugus co. C. Van Deloo, collector. 1863.

214 Chemung beds. Randolph, Cattaraugus co. C. Van Deloo, collector. 1863.

215 Chemung beds. Collected two miles southwest of Steamburg station, Cold Spring, Cattaraugus co. C. Van Deloo, collector. 1863.

216 Chemung beds. Specimens collected at Wolf run, town of Elko, Cattaraugus co. C. Van Deloo, collector. 1863.

217 Chemung beds. Leon village, Cattaraugus co. C. Van Deloo, collector. 1863.

218 Chemung beds. Specimens collected one and a half miles southeast of East Randolph, in the town of Cold Spring. C. Van Deloo, collector. 1863.

219 Chemung beds. Specimens collected at Ellington, Chautauqua co. C. Van Deloo, collector. 1863.

220 Chemung beds. Loose specimens collected along the hill road from Ellington to Cherrycreek. C. Van Deloo, collector. 1863.

221 Chemung beds. Specimens collected on Mr Gardner's farm near Cherrycreek, Chautauqua co. C. Van Deloo, collector. 1863.

222 Chemung beds. Loose specimens collected in the village of Cherrycreek. C. Van Deloo, collector. 1863.

223 Chemung beds. Specimens collected near Horse Corners, township of New Albion, Cattaraugus co. C. Van Deloo, collector. 1863.

224 Chemung beds. Specimens collected at Bear's gulf, one and a half miles west of Horse Corners, New Albion, Cattaraugus co. C. Van Deloo, collector. 1863.

226 Chemung beds. Specimens collected at Meadville, Pa. C. Van Deloo, collector. 1863.

227 Hamilton beds. Specimens collected from ravine, three fourths of a mile northwest of Delphi village. George B. Simpson, collector. 1863.

228 Hamilton beds. Specimens collected from Delphi falls, one mile southeast of village. George B. Simpson, collector. 1863.

229 Hamilton beds. Specimens collected from quarry, two miles southeast of Delphi village. George B. Simpson, collector. 1863.

230 Hamilton beds. Specimens collected from Ten mile point gulf, Skaneateles lake, six miles from the head, east side. George B. Simpson, collector. 1863.

231 Hamilton beds. Specimens collected from the Lower basin gulf, Skaneateles lake, five miles from head of lake, east side. George B. Simpson, collector. 1863.

232 Hamilton beds. Specimens collected from ravines running into Owasco lake, east side, from the head to four miles down. George B. Simpson, collector. 1863.

233 Hamilton beds. Specimens collected from ravines running into Otisco lake, west side. George B. Simpson, collector. 1863.

234 Hamilton beds. Specimens collected from ravines running into Otisco lake, east side. George B. Simpson, collector. 1863.

235 Hamilton beds. Specimens collected from Tinkers falls, four miles from Apulia. R. P. Whitfield and George B. Simpson, collectors. 1863.

236 Tully limestone. Specimens collected from Rhynchonella bed, Tinkers falls. R. P. Whitfield and George B. Simpson, collectors. 1863.

237 Hamilton beds. Specimens collected from ravines running into west side of Onondaga creek, four miles south of Cardiff. George B. Simpson, collector. 1863.

238 Hamilton beds. Specimens collected from ravine running into east side of Onondaga creek, four miles south of Cardiff. George B. Simpson, collector. 1863.

239 Hamilton shales. Specimens collected from loose pieces, half a mile west of village of Lafayette, Onondaga co. George B. Simpson, collector. 1863.

240 Hamilton shales. Specimens collected from Fall brook, one mile below and opposite Skaneateles lake. George B. Simpson, collector. 1863.

241 Hamilton shales. Cyathophylloid corals, from east shore of Skaneateles lake, three miles from head. George B. Simpson, collector. 1863.

242 Hamilton shales. Specimens collected from ravine running into Skaneateles lake, one and a half miles south of Borodino. George B. Simpson, collector. 1863.

243 Hamilton shales. Specimens collected from stream running into Skaneateles lake at Appletree point, west side, four miles from head. George B. Simpson, collector. 1863.

244 Hamilton shales. Specimens collected from stream running into Skaneateles lake at Pray's point, three miles from head, and between that and a point one mile above; west side. George B. Simpson, collector. 1863.

245 Hamilton shales. Specimens collected from ravine, one and a half miles north of Aurora, Cayuga co. George B. Simpson, collector. 1863.

246 Hamilton shales. Specimens collected from falls at Carter's mills, four miles north of Aurora; from top of falls. George B. Simpson, collector. 1863.

247 Hamilton shales. Specimens collected from ravine running into Skaneateles lake, one and a quarter miles south of Borodino. George B. Simpson, collector. 1863.

248 Hamilton shales. Specimens collected from ravine, one and three quarters miles south of Borodino; east side. George B. Simpson, collector. 1863.

249 Hamilton shales. Specimens collected from stream, three fourths of a mile south of Fabius village. George B. Simpson, collector. 1863.

250 Hamilton shales. Specimens collected from a ravine, two miles south of Fabius village. George B. Simpson, collector. 1863.

251 Hamilton shales. Specimens collected from ravines running into Owasco lake, from the head to four miles down, west side. George B. Simpson, collector. 1863.

252 Hamilton shales. Specimens collected from a ravine running into Skaneateles lake, three and a half miles below Borodino. George B. Simpson, collector. 1863.

253 Hamilton shales. Specimens collected from ravine running into Skaneateles lake, three miles from the head, east side. George B. Simpson, collector. 1863.

254 Tully limestone. From a quarry northwest of the village of Tully. R. P. Whitfield and George B. Simpson, collectors. 1863.

255 Tully limestone. From a quarry and ravine south of the railroad station at Tully. R. P. Whitfield and George B. Simpson, collectors. 1863.

256 Hamilton beds. Collected from loose pieces in the vicinity of Tully. R. P. Whitfield and George B. Simpson, collectors. 1863.

257 Chemung beds. Redhouse bridge, on the Atlantic and great western railroad, in the town of Salamanca. C. Van Deloo, collector. 1863.

258 Chemung beds. From Great Valley, Cattaraugus co. C. Van Deloo, collector. 1863.

259 Chemung beds. Three miles north of Olean station, near Erie railroad. C. Van Deloo, collector. 1863.

260 Chemung beds. One and a half miles west of Olean station, Erie railroad. C. Van Deloo, collector. 1863.

261 Chemung beds. Between Olean and Allegany stations, New York and Erie railroad. C. Van Deloo, collector. 1863.

262 Chemung beds. Three miles north of Olean station, New York and Erie railroad. C. Van Deloo, collector. 1863.

263 Chemung beds. Three miles west of Olean station, New York and Erie railroad, in the town of Humphrey. C. Van Deloo, collector. 1863.

264 Chemung beds. Near Little Genesee, Allegany co. C. Van Deloo, collector. 1863.

265 Chemung beds. Three miles south of Olean, Cattaraugus co. C. Van Deloo, collector. 1863.

266 Chemung beds. Carrollton and Allegany stations, New York and Erie railroad. C. Van Deloo, collector. 1863.

267 Chemung beds. Conglomerate. One and a half miles north of Olean village. C. Van Deloo, collector. 1863.

268 Hamilton shales. Fall brook near Geneseo, Livingston co. C. Van Deloo, collector. 1864.

269 Hamilton shales. Mostly from loose masses in the vicinity of Cooperstown. C. Van Deloo, collector. 1864.

270 Chemung group. Conglomerate. From Fortville, eight miles south of Olean. C. Van Deloo, collector. 1864.

271 Onondaga limestone (Upper Helderberg limestone, old record). Specimens collected or purchased at Delaware, O., from the quarries at that place. The beds are in the lower part of the group. R. P. Whitfield, collector. 1865.

272 Onondaga limestone (Upper Helderberg limestone, old record). Specimens collected at the state quarries, Columbus, O., and other quarries near there. R. P. Whitfield, collector. 1865.

273 Onondaga limestone (Upper Helderberg limestone, old record). Specimens collected from a stone heap near Columbus, O., brought from quarries along the railroad. R. P. Whitfield, collector. 1865.

274 Onondaga limestone (Upper Helderberg limestone, old record). Specimens, mostly corals, collected at the falls of the Ohio, on the Jeffersonville side. R. P. Whitfield, collector. 1865.

275 Hamilton shales. The corals are mostly from West Williams and the mollusks from Thedford (Widder), Ontario. John DeCew, collector. 1865.

276 Keokuk group. Specimens collected in the railroad cuts from two to three miles west of New Providence, Ind. R. P. Whitfield, collector. 1865.

277 Hudson river beds. Specimens collected about two miles below Westport, Ky., Ohio river, near the bed of a small stream. R. P. Whitfield, collector. 1865.

278 Hudson river beds. Collected opposite Westport, Ky., on the Indiana side, 15 feet above the water level. R. P. Whitfield, collector. 1865.

279 Hamilton beds. Specimens of mollusca which were among the corals from West Williams, Ontario. J. De Cew, collector. 1865.

280 Hamilton beds. Spirifer mucronatus; mostly from Thedford (Widder), Ontario. J. Hall, J. DeCew and others, collectors. 1865.

281 Oriskany sandstone. Cayuga township, Ontario. John De Cew, collector. 1866.

282 Onondaga limestone (Upper Helderberg limestone, old record). Ontario. J. DeCew, collector. 1866.

283 Helderbergian. Albany co.

284 Helderbergian. Scutella limestone. Albany co.

285 Helderbergian. Pentamerus limestone. Albany co.

286 Tentaculite limestone. Schoharie.

287 Helderbergian. Upper Pentamerus. Schoharie.

288 Helderbergian. Shaly limestone. Schoharie.

289 Helderbergian. Shaly limestone. Herkimer co.
290 Chazy limestone. Chazy.
291 Trenton limestone. Middleville.
292 Trenton limestone. Tribeshill.
293 Trenton limestone. Watertown.
294 Niagara beds. Lockport.
295 Black river limestone. Chazy.
296 Hudson river beds. Ballston.
297 Black river limestone. Watertown.
298 Clinton beds. New Hartford.
299 Niagara beds. Coralline limestone. Schoharie. Specimens numbered 283 to 299 collected by James Hall previous to 1855.
300 Hamilton beds. From Hamilton and vicinity. Madison co. James Hall, collector. 1844.
301 Hamilton beds. Fultonham and vicinity. James Hall, collector. 1844.
302 Hamilton beds. Summit, Schoharie co. James Hall, collector. 1844.
303 Hamilton beds. Schoharie. James Hall, collector. 1844.
304 Ithaca beds (Hamilton group, old record). Oneonta (loose). J. W. Hall, collector. 1869.
305 Ithaca beds (Hamilton group, old record). Bed of rock at Emmons, Otsego co. J. W. Hall, collector. 1869.
306 Ithaca beds (Hamilton group, old record). From cliff on Westkill, two and a half miles northeast of Jefferson, Schoharie co. J. W. Hall and George B. Simpson, collectors. 1869.
307 Ithaca beds (Hamilton group, old record). One quarter of a mile west of Jefferson, Schoharie co. J. W. Hall and George B. Simpson, collectors. 1869.
308 Ithaca beds (Hamilton group, old record). One mile north of Jefferson, on the road to Summit. J. W. Hall and George B. Simpson, collectors. 1869.
309 Ithaca beds (Hamilton group, old record). Collected from a layer of rock about three or four feet above num-

ber 308 and at the same place. J. W. Hall, collector. 1869.

310 Ithaca beds (Hamilton group, old record). From loose pieces collected one mile north of Jefferson, on the road to Summit, Schoharie co. J. W. Hall, collector. 1869.

311 Ithaca beds (Hamilton group, old record). From near Dr Haven's, Jefferson, Schoharie co. Loose pieces. J. W. Hall and George B. Simpson, collectors. 1869.

312 Chemung beds. Loose pieces collected on road, about three miles north of Salamanca, Cattaraugus co., on road to Rock City, half a mile from Rock City. R. P. Whitfield, collector. 1869.

313 Chemung beds. Conglomerate. Salamanca. Collected from the layer in which is found the Hippodophycus cowlesi. R. P. Whitfield, collector. 1869.

314 Hamilton beds. Falls on the stream north of the village of Fultonham, Schoharie co. J. W. Hall and George B. Simpson, collectors. 1869.

315 Hamilton beds. Collected at about the middle of the falls on Lawyer's creek, near Fultonham. J. W. Hall and George B. Simpson, collectors. 1869.

316 Hamilton beds. From the top of the falls on Lawyer's creek, near Fultonham. J. W. Hall and George B. Simpson, collectors. 1869.

317 Hamilton beds. From loose pieces on road running near stream at Watsonville, Schoharie co. J. W. Hall and George B. Simpson, collectors. 1869.

318 Hamilton beds. From loose pieces on creek at Watsonville, Schoharie co. J. W. Hall and George B. Simpson, collectors. 1869.

319 Hamilton beds. Collected from creek in Adam's hollow, Fultonham, Schoharie co. J. W. Hall and George B. Simpson, collectors. 1869.

320 Hamilton beds. Collected from Kenhanagara creek near Fultonham, Schoharie co. J. W. Hall and George B. Simpson, collectors. 1869.

321 Hamilton beds. Collected at West Fulton, on Fultonham road, Schoharie co. J. W. Hall and George B. Simpson, collectors. 1869.

322 Ithaca beds (Hamilton group, old record). Loose pieces collected from bed of small creek, west side of Schoharie creek, two and a half miles north of Blenheim, Schoharie co. J. W. Hall and George B. Simpson, collectors. 1869.

323 Ithaca beds (Hamilton group, old record). Cliff, west side of Schoharie creek, one mile north of Blenheim. J. W. Hall and George B. Simpson, collectors. 1869.

324 Ithaca beds (Hamilton group old record). Collected at side of road, west side of Schoharie creek, two and a half miles north of Blenheim. J. W. Hall and George B. Simpson, collectors. 1869.

325 Hamilton beds. Collected from bottom of high cliff on east side of Schoharie creek, one mile below Breakabeen, Schoharie co. J. W. Hall and George B. Simpson, collectors. 1869.

326 Hamilton beds. From near mouth of Kenhanagara creek, west side of Schoharie creek, between Fultonham and Breakabeen. J. W. Hall and George B. Simpson, collectors. 1869.

327 Hamilton beds. Collection of 1844. James Hall, collector.

328 Chemung beds. Collected at the sawmill one and a half miles east of Portville village. R. P. Whitfield, collector. 1869.

329 Chemung beds. Loose pieces plowed up on hillside northeast of Portville village. R. P. Whitfield, collector. 1869.

330 Chemung beds. Conglomerate. Loose at base of hill back of village of Portville, on opposite side of river. R. P. Whitfield, collector. 1869.

331 Chemung beds. Specimens collected from a hard band of sandstone in the bed of Van Campen's creek, at the

railroad bridge, Hobbieville, Allegany co. R. P. Whitfield, collector. 1869.

332 Chemung beds. Collected from blocks brought to build bridge piers at Hobbieville. R. P. Whitfield, collector. 1869.

333 Chemung beds. Collected from the shales above the gray band at Hobbieville, and along the creek above that place. R. P. Whitfield, collector. 1869.

334 Chemung beds. Shale above gray band on Van Campen's creek, bed nearly opposite Belvidere station, in bottom of stream. R. P. Whitfield, collector. 1869.

335 Chemung beds. From a gray band found loose in bottom of Van Campen's creek. The bed recognized farther north at Angelica. R. P. Whitfield, collector. 1869.

336 Potsdam sandstone. Lingula, Obolella and trilobites, Keeseville. R. P. Whitfield, collector. 1867.

337 Chemung beds. From a gray band in bed of stream under dam at Hull's mills near Angelica (= gray band at Hobbieville). R. P. Whitfield, collector. 1869.

338 Chemung beds. Shales above gray band at Hull's mills, Angelica. R. P. Whitfield, collector. 1869.

339 Ithaca beds (Portage group, old record). Collected near Ithaca, and north of Ithaca, near lake shore. James Hall, collector. 1865.

340 Hamilton shales. Collected at York, Livingston co. C. Van Deloo, collector. 1865.

341 Hamilton shales. Collected at Fall brook, near Geneseo. C. Van Deloo, collector. 1865.

342 Hamilton shales. Two miles east of Geneseo. C. Van Deloo, collector. 1865.

343 Hamilton shales. Railroad depot at Geneseo. C. Van Deloo, collector. 1865.

344 Oriskany sandstone. Drift specimens collected at Aurora. J. W. Hall and C. Van Deloo, collectors. 1867.

345 Hamilton shales. Collected on the shore of Cayuga lake, south of Aurora. J. W. Hall and C. Van Deloo, collectors. 1867.

346 Helderbergian group. Becraft mountain, Hudson. R. P. Whitfield, collector. 1865 or 1866.

347 Chemung beds. Upper part of the series exposed at Ithaca. James Hall, collector. 1868.

348 Onondaga limestone (Upper Helderberg limestone, old record). Loose pieces near Hamburg, shore of Lake Erie. C. Van Deloo, collector. 1865.

349 Hamilton shales. Collected at Hamburg on the shore of Lake Erie and vicinity. J. W. Hall and C. Van Deloo, collectors. 1865.

350 Oriskany sandstone. Collected at Devil's Half Acre, eight miles southwest of Auburn. J. W. Hall and C. Van Deloo, collectors. 1866.

351 Oriskany sandstone. Collected at a locality five miles east of Union Springs (Springville). J. W. Hall and C. Van Deloo, collectors. 1866.

352 Hamilton shales. Collected at Bellona. J. W. Hall and C. Van Deloo, collectors. 1866.

353 Hamilton shales. Collected near Lodi landing, Seneca lake. J. W. Hall and C. Van Deloo, collectors. 1866.

354 Tully limestone. Collected below Lodi landing, Seneca lake. J. W. Hall and C. Van Deloo, collectors. 1866.

355 Marcellus shale. Collected two miles below Lodi landing, Seneca lake. J. W. Hall and C. Van Deloo, collectors. 1866.

356 Genesee shales. Black stream landing, Seneca lake. J. W. Hall and C. Van Deloo, collectors. 1866.

357 Hamilton shales. Ogdens ferry, Cayuga lake. J. W. Hall and C. Van Deloo, collectors. 1866.

358 Genesee shales. Near Kidders landing, Cayuga lake. J. W. Hall and C. Van Deloo, collectors. 1866.

359 Hamilton shales. Ludlowville. J. W. Hall and C. Van Deloo, collectors. 1866.

360 Hamilton shales. Collected at Darien, Genesee co. C. Van Deloo, collector. 1865.

361 Hamilton shales. Collected at Moscow, Livingston co. C. Van Deloo, collector. 1865.

362 Hamilton shales. Collected at Bethany, Genesee co. C. Van Deloo, collector. 1865.

363 Genesee shales. Three miles south of Mount Morris. C. Van Deloo, collector. 1865.

364 Genesee shales. Collected at Moscow. C. Van Deloo, collector. 1865.

365 Hudson river beds, etc. Drift. Rock Stream, west shore of Seneca lake. J. W. Hall and C. Van Deloo, collectors. 1866.

366 Hamilton shales. Near Dresden. J. W. Hall and C. Van Deloo, collectors. 1866.

367 Portage beds. Four miles south of Penn Yan. J. W. Hall and C. Van Deloo, collectors. 1866.

368 Portage beds. Between Rock landing and Rock Stream, west shore of Seneca lake. J. W. Hall and C. Van Deloo, collectors. 1866.

369 Genesee shales. Between Rock Stream and Rock landing, west shore of Seneca lake. J. W. Hall and C. Van Deloo, collectors. 1866.

370 Hamilton beds. Loose pieces. Gilboa, Schoharie co. J. W. Hall and George B. Simpson, collectors. 1869.

371 Hamilton beds. Earlville, Madison co. George B. Simpson, collector. 1871.

372 Hamilton beds. Pratts falls (top of falls), Pompey, Onondaga co. George B. Simpson, collector. 1871.

373 Ithaca beds. Ravine running through village of New Berlin. J. W. Hall and George B. Simpson, collectors. 1870.

374 Catskill beds. Richmond quarries. Mount Upton. J. W. Hall and George B. Simpson, collectors. 1870.

375 Ithaca beds. Mount Upton and White Store. J. W. Hall and George B. Simpson, collectors. 1870.

376 Hamilton shales. Darien. C. Van Deloo, collector. 1874.

377 Hamilton shales. York, Livingston co.

379 Hamilton shales. Collected in railroad cut two and a half miles east of Alden station. C. Van Deloo, collector. 1874.

383 Hamilton shales. Collected at Cornell's storehouse, west side of Cayuga lake, about eight miles north of Ithaca. J. W. Hall, collector. 1866.

384 Hamilton shales. Fossils collected on Cashong creek, Bellona, Yates co. J. W. Hall and C. Van Deloo, collectors. 1866.

385 Hamilton shales. Fossils collected at Norton's landing, east side of Cayuga lake, eight miles north of Ithaca. J. W. Hall, collector. 1866.

386 Hamilton shales. Specimens collected at Pratts falls, Onondaga co. C. Van Deloo and H. H. Smith, collectors. 1874.

387 Tully limestone. Fossils collected at Bellona. J. W. Hall and C. Van Deloo, collectors. 1866.

388 Oriskany sandstone. Knox, Albany co. James Hall, collector.

389 Onondaga limestone. Specimens of Amphigenia elongata from old collection of 1844.

390 Ithaca beds (Chemung group, old record). Fossil plants collected on the west side of Cayuga lake inlet, about one quarter of a mile below the railroad depot on opposite side. J. W. Hall and C. Van Deloo, collectors. 1866.

391 Ithaca beds (Chemung group, old record). Fossils collected at Mr Cornell's quarry, one mile northeast of Ithaca; also from cemetery quarry and Cascadilla creek. J. W. Hall and C. Van Deloo, collectors. 1866.

392 Ithaca beds (Chemung group, old record). Fossils collected at the old inclined plane, one mile southeast of Ithaca. J. W. Hall and C. Van Deloo, collectors. 1866.

393 Chemung beds. Fossils collected at Dryden. J. W. Hall and C. Van Deloo, collectors. 1866.

394 Chemung beds. Fossils collected at Cayuta creek, Tompkins co. J. W. Hall and C. Van Deloo, collectors. 1866.

395 Ithaca beds (Portage group, old record). Fossils collected mostly on the lighthouse pier, Ithaca. J. W. Hall and C. Van Deloo, collectors. 1866.

396 Chemung beds. Fossils collected at Elmira. J. W. Hall and C. Van Deloo, collectors. 1866.

397 Chemung beds. Fossils collected at Chemung narrows. J. W. Hall and C. Van Deloo, collectors. 1866.

398 Hamilton beds. Hamilton, Madison co. J. Hall, collector. 1862.

399 Hamilton beds. Lamellibranchs. Cazenovia. J. Hall, collector. 1862.

400 Onondaga stage? (Hamilton group? old record). Specimens collected at and in the vicinity of Waterloo, Ia. R. P. Whitfield, collector. 1866.

401 Chemung stage. Specimens collected at a locality one and a half miles above Rockford, Ia., on Lime creek, except the unweathered specimens of Stromatopora, which were from the ledges along the creek above the mill. R. P. Whitfield, collector. 1866.

402 Upper Devonic (Chemung group? old record). Specimens collected at Hackberry, eight miles above Rockford, Ia., on Lime creek, in a bed having the same position as that one and a half miles above Rockford. R. P. Whitfield, collector. 1866.

403 Upper Devonic (Hamilton group? old record). Specimens collected at Waverly, Ia., on the bank of the Cedar river, above and below the village. R. P. Whitfield, collector. 1866.

404 Upper Devonic (Hamilton group? old record). Specimens collected at Independence, Ia. R. P. Whitfield, collector. 1866.

405 Chemung beds. Franklin, Delaware co. James Hall, collector. 1862.

405a Ithaca beds (Hamilton group? old record). Near Blenheim, below high hill and south of village. James Hall, collector. 1862.

405b Ithaca beds (Chemung group? old record). Near the summit going from head of Delaware river to Blenheim. James Hall, collector. 1862.

407 Portage beds. Three miles south of Mount Morris. C. Van Deloo, collector.

408 Hamilton beds. From Pratts falls, same side as mills, 100 feet from base, Pompey, Onondaga co. George B. Simpson, collector. 1871.

409 Hamilton beds. From Delphi falls, Delphi, Onondaga co. George B. Simpson, collector. 1871.

410 Keokuk beds. Crawfordsville, Ind. C. Van Deloo, collector. 1867.

411 Keokuk beds. Four miles south of Crawfordsville, Ind., at Sugar creek. C. Van Deloo, collector. 1867.

412 Keokuk beds. Specimens collected at Johnsville, one mile southwest on Offiel's creek, near Crawfordsville, Ind. C. Van Deloo, collector. 1867.

413 Keokuk beds. Specimens collected at Black creek, near Crawfordsville, Ind. C. Van Deloo, collector. 1867.

414 Keokuk beds. Specimens collected at the Walnut fork of Sugar creek, four miles from Crawfordsville, Ind. C. Van Deloo, collector. 1867.

415 Chemung beds. Rockville, Allegany co. Collected at Lock number? from layers of sandstone at the top of the bank, and above the green shales. R. P. Whitfield and C. Van Deloo, collectors. 1869.

416 Chemung beds. Rockville, Allegany co. at Lock number? from the green shales near the level of canal. R. P. Whitfield and C. Van Deloo, collectors. 1869.

417 Chemung beds. Collected at Phillipsburg, Allegany co., just below the dam at mill. R. P. Whitfield and C. Van Deloo, collectors. 1869.

418 Chemung beds. Rockville, Allegany co., from a quarry of gray sandstone used for building, situated on the side of a hill, on the opposite side of the creek from the canal, representing the same layer as that found at Hobbie-

ville and Angelica, and below the green shales. R. P. Whitfield and C. Van Deloo, collectors. 1869.

419 Marcellus shale. Creek at West Avon. C. Van Deloo, collector. 1865.

420 Onondaga limestone. Below mills at West Avon. (Some specimens are from the Marcellus shale.) C. Van Deloo, collector. 1865.

421 Hamilton shales. Jaycox run, between Geneseo and Avon. C. Van Deloo, collector. 1865.

422 Chemung beds. Loose specimens overlying the conglomerate at Rock City, three and a half miles north of Salamanca. R. P. Whitfield, collector. 1869.

423 Hamilton beds. Fossils collected from Sherburne creek, below falls, Chenango co. J. W. Hall and George B. Simpson, collectors.

424 Ithaca beds (Hamilton group, old record). From creek one mile below Norwich, Chenango co. J. W. Hall and George B. Simpson, collectors.

425 Ithaca beds (Chemung group, old record). Lower part of formation, Ithaca. J. W. Hall and George B. Simpson, collectors. 1870.

426 Chemung beds. Specimens collected from a bed of conglomerate at Clark's farm near Panama, Chautauqua co. James Hall, collector. 1870.

427 Chemung beds. Specimens collected from above the conglomerate at Clark's farm near Panama. James Hall, collector. 1870.

428 Hamilton shales. Specimens collected at Shurger's glen, near Norton's landing, Cayuga lake, half way up the side of the third fall (going up from the lake), $11\frac{1}{2}$ feet below the Tully limestone (division 2, stratum 10 of section). Herbert H. Smith, collector. 1871.

429 Hamilton shales. Specimens collected at Vinegar brook glen, near Norton's landing, Cayuga lake, near the top of the lower fall, about 150 feet below Tully limestone. Herbert H. Smith, collector. 1871.

430 Hamilton shales. Specimens collected at Shurger's glen, near Norton's landing, Cayuga lake, from loose fragments fallen from about 15 feet below the Tully limestone (division 3 of section). Herbert H. Smith, collector. 1871.

431 Hamilton shales. Specimens collected at Shurger's glen, near Norton's landing, Cayuga lake, from loose fragments fallen from about 15 feet below the Tully limestone (division 3 of section). Herbert H. Smith, collector. 1871.

432 Hamilton shales. Specimens collected at Vinegar brook glen, Norton's landing, Cayuga lake, from hard shales, half way up the lower fall. Herbert H. Smith, collector. 1871.

433 Hamilton shales. Specimens collected at Shurger's glen, Norton's landing, Cayuga lake, in a layer of hard calcareous rock (about eight inches) and in the fine shale immediately above and below this layer, about 25 feet below the Tully limestone and 20 rods below where the stream falls over it. Herbert H. Smith, collector. 1871.

434 Hamilton shales. Specimens collected at Shurger's glen, Norton's landing, Cayuga lake, in the shale about 18 feet below the Tully limestone, and immediately below the fall formed by that rock (12th layer, 3d division, below Tully limestone). Herbert H. Smith, collector. 1871.

435 Hamilton shales. Specimens collected at Ludlowville, Tompkins co., in the shale, about 20 feet below the Tully limestone. In a glen formed by a small brook which flows into Ludlowville creek on the south side, nearly opposite the village, about half way up the glen. Herbert H. Smith, collector. 1871.

436 Hamilton shales. Specimens collected in the fine trilobite shales about 25 feet above the Encrinal limestone. Shurger's glen, Norton's landing, Cayuga lake. Herbert H. Smith, collector. 1871.

437 Hamilton shales. Specimens collected from loose fragments fallen from about 15 feet below the Tully limestone. Shurger's glen, Norton's landing, Cayuga lake. Herbert H. Smith, collector. 1871.

438 Hamilton shales. Specimens collected at the lower fall, Vinegar brook glen, Norton's landing, Cayuga lake. Herbert H. Smith, collector. 1871.

439 Hamilton shales. Specimens collected at Shurger's glen, Norton's landing, Cayuga lake, in the hard shale about 12 feet below the Tully limestone (Division 2, stratum 10 of section). Herbert H. Smith, collector. 1871.

440 Hamilton shales. Specimens collected at the middle fall, Shurger's glen, Norton's landing, Cayuga lake. Herbert H. Smith, collector. 1871.

441 Hamilton shales. Specimens collected at Shurger's glen, Norton's landing, Cayuga lake, in loose fragments fallen from strata lying 20 to 30 feet below the Tully limestone. Herbert H. Smith, collector. 1871.

442 Hamilton shales. Specimens collected at Ludlowville, Tompkins co., in a mass of rock, fallen from about 30 feet below the Tully limestone, below the lower bridge. Herbert H. Smith, collector. 1871.

443 Hamilton shales. Specimens collected on the east shore of Cayuga lake, two miles south of Norton's landing, in the fine shale immediately below the Tully limestone. Herbert H. Smith, collector. 1871.

444 Hamilton shales. Specimens collected at Shurger's glen, Norton's landing, Cayuga lake, in the coarse shales about 12 feet below the Tully limestone, and just below the falls formed by that rock. Herbert H. Smith, collector. 1871.

445 Hamilton shales. Specimens collected at Vinegar brook glen, Norton's landing, Cayuga lake; in a loose fragment of rock probably fallen from about 100 feet below the Tully limestone. Herbert H. Smith, collector. 1871.

446 Hamilton shales. Specimens collected at Shurger's glen, Norton's landing, Cayuga lake, in the shale about 15 feet

below the Tully limestone, and at the foot of the fall, over that rock. Herbert H. Smith, collector. 1871.

447 Hamilton shales. Specimens collected from a loose fragment, fallen from about five feet below the Tully limestone, near the falls over that rock. Shurger's glen, Norton's landing, Cayuga lake. Herbert H. Smith, collector. 1871.

448 Hamilton shales. Specimens collected at the lower fall, Vinegar brook glen, Norton's landing, Cayuga lake. Herbert H. Smith, collector. 1871.

449 Hamilton shales. Specimens collected at Shurger's glen, Norton's landing, Cayuga lake. In the shale immediately below the Tully limestone at the fall over that rock. Herbert H. Smith, collector. 1871.

450 Catskill beds. Specimens collected from a thin bed of calcareous rock in the Catskill group on Seeley creek (branch of Lamb's creek), four miles northwest of Mansfield, Tioga co., Pa. They occur in bed 11, section 1. Andrew Sherwood, collector, 1871.

451 Catskill beds. Specimens from a fish-bed on Seeley creek (branch of Lamb's creek), four miles northwest of Mansfield, Tioga co., Pa. They occur in bed 19, section 1. Andrew Sherwood, collector. 1871.

452 Catskill beds. Specimens from the west bank of the Tioga river, near the mouth of Lamb's creek, three miles north of Mansfield, Tioga co., Pa. They occur in bed 5, section 3. Andrew Sherwood, collector. 1871.

453 Catskill beds. West bank of the Tioga river, three miles north of Mansfield, Tioga co., Pa. Bed 4, section 3. Andrew Sherwood, collector. 1871.

454 Catskill beds. West bank of Tioga river, three miles north of Mansfield, Pa. Bed 14, section 3. Andrew Sherwood, collector. 1871.

455 Chemung beds. Specimens from bed 1, section 1, four miles northwest of Mansfield, Pa. Andrew Sherwood, collector. 1871.

456 Catskill beds. West bank of Tioga river, three miles north of Mansfield, Pa. Bed 3, section 3. Andrew Sherwood, collector. 1871.

457 Chemung beds. Specimens from Kelly creek, two miles northeast of Mansfield, Pa. From bed 9, section 4. Andrew Sherwood, collector. 1871.

458 Chemung beds. Specimens from Kelly creek, two miles northeast of Mansfield, Pa. Found in bed 5, section 4. Andrew Sherwood, collector. 1871.

459 Chemung beds. Specimens from railroad cut, east of Tioga village, Tioga co., Pa. Andrew Sherwood, collector. 1871.

460 Chemung beds. Specimens from a small stream coming into Tioga river from the west, two miles north of Mansfield, Pa. Andrew Sherwood, collector. 1871.

461 Chemung and Catskill beds. Lithologic specimens from Seeley creek (branch of Lamb's creek), four miles northwest of Mansfield, Pa. (The numbers in ink on the specimens correspond to the number on section 1.) Andrew Sherwood, collector. 1871.

462 Hamilton shales. Specimens collected in the fine shale, immediately below the Tully limestone, two miles south of Norton's landing, Cayuga lake; near where the Tully limestone runs down into the lake. Herbert H. Smith, collector. 1871.

463 Hamilton shales. Specimens collected at Vinegar brook glen, Norton's landing, Cayuga lake, in the dark shales about 100 feet below the Tully limestone. Herbert H. Smith, collector. 1871.

464 Hamilton shales. Specimens collected on the shore of Cayuga lake, in the shale immediately below the Tully limestone, two miles south of Norton's landing. Herbert H. Smith, collector. 1871.

465 Hamilton shales. Specimens collected on the east shore of Cayuga lake, at various points, from half a mile to two miles south of Norton's landing. Herbert H. Smith, collector. 1871.

466 Hamilton shales. Specimens collected on the west shore of Cayuga lake, opposite Norton's landing. Herbert H. Smith, collector. 1871.

467 Hamilton shales. Specimens collected at Shurger's glen, Norton's landing, Cayuga lake; in the dark shale about 120 feet below the Tully limestone (Trilobite shales). Herbert H. Smith, collector. 1871.

468 Hamilton shales. Specimens collected at Shurgers glen, Norton's landing, Cayuga lake, in the shale about 100 feet below the Tully limestone. Herbert H. Smith, collector. 1871.

469a Hudson river beds. Specimens collected near Cincinnati, O. Herbert H. Smith, collector.

469b Oneonta sandstone. Specimens collected at Richmond's quarry, near Mount Upton. Andrew Sherwood, collector. 1871.

470 Chemung sandstone. Neighborhood of Mansfield, Pa. Andrew Sherwood, collector. 1871.

471 Chemung sandstone. Specimens collected at Erwin Center, Steuben co. Andrew Sherwood, collector. 1871.

472 Chemung sandstone. Specimens collected at Mansfield, Pa. Andrew Sherwood, collector. 1871.

473 Chemung sandstone. Collected between Corning and Elmira. Andrew Sherwood, collector. 1871.

474 Catskill sandstone. Specimens collected on the east bank of the Susquehanna river, above and near Towanda, Bradford co., Pa. Andrew Sherwood, collector. 1871.

475 Lower Carbonic. Conglomerate. Below Millstone grit, halfway between Bradford and Farmers Valley, McKean co., Pa. Andrew Sherwood, collector. 1871.

476 Hamilton beds. Near Monroe, Orange co. C. Van Deloo, collector. 1870.

477 Chemung beds? Conglomerate. South of Smethport, Pa. C. Van Deloo, collector. 1870.

477½ Chemung beds? Conglomerate, higher bed. South of Smethport, Pa. C. Van Deloo, collector. 1870.

478 Chemung beds? Conglomerate. West of Smethport, Pa. Olean road; Alton road. C. Van Deloo, collector. 1870.

479 Chemung beds? Conglomerate. Southeast of Smethport, Pa. C. Van Deloo, collector. 1870.

480 Chemung beds. East of Smethport, Pa. C. Van Deloo, collector. 1870.

480+ Chemung beds? Conglomerate. Higher bed, west of Smethport, Pa.; Olean road. C. Van Deloo, collector. 1870.

481 Chemung beds? Conglomerate. South of Grant Station and Panama. C. Van Deloo, collector. 1870.

482 Waverly group. Oil City, Pa. C. Van Deloo, collector. 1870.

483 Waverly group. Between Millers and Shafers, Pa. C. Van Deloo, collector. 1870.

484 Chemung beds? Shales and sandstone above conglomerate, south of Panama, N. Y., and north of Pine Valley, James Hall, collector. 1870.

485 Chemung beds? Immediately above the conglomerate. Roadside southwest of Panama. James Hall, collector. 1870.

486 Chemung beds. Road from Watkins to Elmira and neighborhood of Elmira, etc. C. Van Deloo, collector. 1870.

487 Chemung beds. North of Elmira and at Horseheads. C. Van Deloo, collector. 1870.

488 Chemung beds. Corning. C. Van Deloo, collector. 1870.

489 Chemung beds. North of, and near Elmira. C. Van Deloo, collector. 1870.

490 Chemung beds. Near Elmira? C. Van Deloo, collector. 1870. Some marked 490 have been identified as Hamilton and those recognized are marked 490a. These are probably from drift specimens of the Hamilton rock.

491 Chemung beds. Loose fragments at Clark's farm, two miles southeast of Panama. James Hall, collector. 1870.

492 Chemung beds. Loose fragments at Clark's farm, near Panama. Specimens evidently from layer near by. James Hall, collector. 1870.

493 Chemung beds. Clark's farm, near Panama; loose in creek on east side of valley. James Hall, collector. 1870.

494 Chemung beds. From boulder, on road to Clark's farm, east side of Panama. James Hall, collector. 1870.

495 Chemung beds. Roadside south of Panama (above conglomerate). James Hall, collector. 1870.

496 Hamilton shales. From the "Horn rock," Skaneateles lake, three miles from head of lake. J. W. Hall and George B. Simpson, collectors. 1872.

497 Hamilton shales. From falls opposite Borodino, Skaneateles lake. J. W. Hall and George B. Simpson, collectors. 1872.

498 Hamilton shales. From Otisco lake, three miles east of Borodino. J. W. Hall and George B. Simpson, collectors. 1872.

499 Hamilton shales. From bed of creek entering Skaneateles lake at Borodino. J. W. Hall and George B. Simpson, collectors. 1872.

500 Hamilton shales. Pratts falls, Onondaga co. J. W. Hall and George B. Simpson, collectors. 1872.

502 Clinton beds. Specimens collected at Soldiers home quarries, Dayton, O. R. P. Whitfield, collector. 1873.

503 Hudson river beds. Specimens collected on Vine street hill, Cincinnati, O. R. P. Whitfield, collector. 1873.

504 Niagara beds. Fossils collected at Yellowsprings, O. (Mostly Pentamerus oblongus). R. P. Whitfield, collector. 1873.

505 Marcellus shale. Avon. James Hall, collector.

506 Marcellus shale. Le Roy. James Hall, collector.

507 Hudson river beds. Collected at and in the vicinity of Waynesville, O. (Part of them obtained from Jesse Vanduser of Waynesville.) R. P. Whitfield, collector. 1873.

508 Hudson river beds. Collected at Cincinnati, O. Herbert H. Smith, collector. 1871.

509 Tentaculite limestone. From stone wall, one mile west of Clockville, Madison co. George B. Simpson, collector. 1873.

510 Salina beds. Hopper-shaped crystals and other geologic specimens, from three fourths of a mile southeast of Clockville. George B. Simpson, collector. 1873.

511 Ithaca beds. (Chemung group, old record.) Fossils collected at the old inclined plane, one mile southeast of Ithaca. C. Van Deloo, collector. 1874.

512 Helderbergian group and waterlime. Crinoids and Eurypterus; Jerusalem hill, Litchfield. George B. Simpson, collector. 1873.

513 Lower Carbonic. Fossils from a small stream coming into Towanda creek from the west, one mile south of Canton, Bradford co., Pa. The shaly specimens came from the solid rocks above the Mansfield iron ore to less than 40 feet from the bottom of the old bed. All are supposed to have come from above the conglomerate. A. Sherwood, collector. 1871.

514 Ithaca beds (Hamilton group, old record). Specimens from two large loose rocks on the Catskill turnpike, two or three miles east of Stamford, Delaware co. A. Sherwood, collector. 1871.

516 Chemung sandstone. Specimens from Sullivan township, Tiago co., Pa. Supposed to have come from below the conglomerate. A. Sherwood, collector. 1871.

518 Chemung sandstone. Specimens from Belmont, Allegany co. Horizon below the conglomerate. A. Sherwood, collector. 1871.

519 Chemung sandstone. Specimens from Belvidere, Allegany co. Horizon below the conglomerate. A. Sherwood, collector. 1871.

520 Chemung sandstone. Specimens from Mansfield, Pa. Andrew Sherwood, collector. 1871.

521 Chemung sandstone. Specimens from Mansfield, Pa. Supposed to have come from below the conglomerate. A. Sherwood, collector. 1871.

522 Lower Carbonic? Specimens from loose stones on the side of the America mountains above the fish-bed at Redrock, Pa. Have come from above the Old red, or are drifted specimens. A. Sherwood, collector. 1871.

523 Chemung sandstone. Specimens from Sullivan township, Tioga co., Pa. Supposed to have come from below the conglomerate. Andrew Sherwood, collector. 1871.

524 Upper Chemung sandstone. Specimens from Sullivan township, Tioga co., Pa. Andrew Sherwood, collector. 1871.

525 Chemung sandstone. Specimens from the upper Chemung at Mansfield, Pa. A. Sherwood, collector. 1871.

526 Chemung sandstone. Specimens from Sullivan township, Tioga co., Pa. Supposed to have come from below the conglomerate. Andrew Sherwood, collector. 1871.

527 Chemung sandstone. Specimens from Lawrenceburg, Tioga co., Pa. Supposed to be from below the conglomerate. Andrew Sherwood, collector. 1871.

528 Ithaca beds (Chemung group, old record). Specimens from the top of the hill, one mile east of Charlotteville, Schoharie co. Horizon supposed to be above the conglomerate, or about the same as Mount Upton. A. Sherwood, collector. 1871.

529 Chemung beds. Between Monroeton and Towanda, Bradford co., Pa. Supposed to be below the conglomerate. Among these are specimens of Spirifer mesastrialis, which is restricted to lower beds of Chemung. Andrew Sherwood, collector. 1871.

529¼ Chemung beds. Specimens from Great Bend, Susquehanna co., Pa. Supposed to be above conglomerate. Andrew Sherwood, collector. 1871.

529½ Chemung beds. Orwell township, Bradford co., Pa. Below conglomerate. Andrew Sherwood, collector. 1871.

529¾ Chemung group. LeRaysville, Pike township, Bradford co., Pa. Transition rocks between Chemung and Catskill. Above conglomerate. Andrew Sherwood, collector. 1871.

530 Chemung beds. Ferns and fucoids from Montrose, Susquehanna co., Pa. From above the conglomerate. Andrew Sherwood, collector. 1871.

531 Chemung beds. Two miles southwest of Monroeton, Bradford co., Pa. Near the conglomerate. Andrew Sherwood, collector. 1871.

531½ Chemung beds. Near LeRoy, Bradford co., Pa. Horizon of the conglomerate. Andrew Sherwood, collector. 1871.

532 Ithaca beds (Chemung group, old record). Two miles west of Morris, Otsego co.; top of hill on road to South New Berlin. Andrew Sherwood, collector. 1871.

533. Chemung beds. Mansfield, Pa. Below the conglomerate. Andrew Sherwood, collector. 1871.

534 Ithaca beds (Chemung group, old record). Ithaca. Andrew Sherwood, collector. 1871.

535 Ithaca beds (Chemung and Hamilton groups, old record). Specimens from Norwich. Andrew Sherwood, collector. 1871.

536 Ithaca beds (Chemung group, old record). Between Marathon and Harford, Cortland co. Andrew Sherwood, collector. 1871.

537 Hamilton shales. Norton's landing, Cayuga lake. Andrew Sherwood, collector. 1871.

538 Chemung beds. From Mansfield, Pa. Specimens mostly small Pterinea; below conglomerate. Andrew Sherwood, collector. 1871.

539 Catskill beds. Redrock near Blossburg, Tioga co., Pa. Andrew Sherwood, collector. 1871.

540 Catskill beds. Old red. Fish remains, Seeley's creek, three miles northwest of Mansfield, Pa. Andrew Sherwood, collector. 1871.

541 Catskill beds. At Ogdens Corners, Union township, Tioga co. Supposed to be below the conglomerate. Andrew collector. 1871.

542 Chemung beds. Cook's creek, Lindley township, Steuben co. Supposed to be below the conglomerate. Andrew Sherwood, collector. 1871.

543 Chemung beds. Conglomerate near base; mill stream north and west of Panama, Chautauqua co., at base of 80 foot exposure. James Hall, collector. 1871.

544 Chemung beds. Kelley's creek near Mansfield, Pa. Below the conglomerate. Andrew Sherwood, collector. 1871.

545 Upper Chemung beds. From tunnel on Midland railroad, two miles east of Hancock, Delaware co. Andrew Sherwood, collector. 1871.

546 Chemung beds? Fish remains, shells, etc., from the Mansfield iron ore bed, two and a half miles south of Canton, Bradford co., Pa., on Towanda creek and on land of Mr Sullard. They are supposed to have come from above the conglomerate. Andrew Sherwood, collector. 1871.

546a Chemung beds. The iron ore and fish remains are marked 546. The Grammysia and Productus, not in iron, are marked 546a. A. Sherwood, collector. 1871.

547 Catskill beds. Specimens from Lamb's creek, Tioga co., Pa. Andrew Sherwood, collector. 1871.

548 Catskill beds. Specimens from Tioga, Tioga co., Pa. Andrew Sherwood, collector. 1871.

549 Chemung beds. Specimens from Mansfield, Pa. Below the conglomerate. Andrew Sherwood, collector. 1871.

550 Hamilton shales. Specimens collected at Norton's landing, Cayuga lake. C. Van Deloo, collector. 1874.

551 Hamilton shales. Specimens collected one and a half miles north of the railroad station, west side of Cayuga lake, near Ithaca. C. Van Deloo, collector. 1874.

552 Portage beds. East side of Cayuga lake, near Ithaca. C. Van Deloo, collector. 1874.

553 Agoniatites limestone. Specimens from near Manlius. Herbert H. Smith, collector. 1873.

554 Hamilton shales. Specimens collected at Delphi. C. Van Deloo and H. H. Smith, collectors. 1873.

554a Hamilton shales. Specimens collected at Delphi. J. W. Hall and George B. Simpson, collectors. 1875.

555 Specimens illustrating a section of the strata of the southern counties of New York. James Hall and George B. Simpson, collectors. 1875.

556 Hamilton beds. Pratts falls, upper beds. George B. Simpson, collector. 1873 and 1875.

557 Hamilton beds. Ludlowville, Cayuga co. George B. Simpson, collector. 1872.

558 Hamilton beds. Norwich, Chenango co. George B. Simpson, collector. 1875.

559 Hamilton beds. Fultonham and Summit. George B. Simpson, collector. 1875.

560 Pentamerus limestone. Clarksville, Albany co. L. E. Brown and C. Van Deloo, collectors. 1876.

561 Onondaga limestone. Clarksville. L. E. Brown and C. Van Deloo, collectors. 1876.

562 Schoharie grit. Clarksville. L. E. Brown and C. Van Deloo, collectors. 1876.

563 Tentaculite limestone. Clarksville. L. E. Brown and C. Van Deloo, collectors. 1876.

564 Chemung sandstone. Lawrenceville, Tioga co., Pa. Horizon below the conglomerate. Andrew Sherwood, collector. 1871.

565 Upper Chemung beds. Specimens from one and a half miles east of Bennett's hotel, in the road and near the center of Auburn township, Susquehanna co., Pa. Andrew Sherwood, collector. 1870.

566 Chemung beds. Specimens from Addison and Bath, Steuben co. Andrew Sherwood, collector. 1871.

567 Chemung beds. From Adrian, on the Canisteo river, Steuben co. Andrew Sherwood, collector. 1871.

567a Chemung beds. Railroad cut three miles west of Allegany, Cattaraugus co. Andrew Sherwood, collector. 1871.

567b Chemung beds. Elm Valley, Allegany co. Andrew Sherwood, collector. 1871.

567c Chemung beds. Belmont, Allegany co. Andrew Sherwood, collector. 1871.

567d Chemung beds. Vespertine, head of Rock run, five miles east of Allegany river, McKean co., Pa. Andrew Sherwood, collector. 1871.

567e Chemung beds. Cuba, Allegany co. Andrew Sherwood, collector. 1871.

567f Specimens illustrating the strata between Ludlowville and Ithaca on the shore of Cayuga lake. Andrew Sherwood, collector. 1871.

567g Chemung beds. Howard, Steuben co. Andrew Sherwood, collector. 1871.

568 Chemung beds. Specimens from Mehoopany, Wyoming co., Pa. Andrew Sherwood, collector. 1871.

568a Chemung beds. On Phillip's creek, three miles east of Belmont, Allegany co. Horizon supposed to be below the conglomerate. Andrew Sherwood, collector. 1871.

568b Chemung beds. Rummerfield Creek, Bradford co., Pa. Andrew Sherwood, collector. 1871.

568c Chemung beds. From the top of a hill at Rummerfield Creek, Wysox township, Bradford co., Pa. Andrew Sherwood, collector. 1871.

568d Chemung beds. Windham township, Wyoming co., Pa. Andrew Sherwood, collector. 1871.

569 Chemung beds. Bakers Bridge, Allegany co. Horizon below the conglomerate. Andrew Sherwood, collector. 1871.

569a Upper Chemung beds. Specimens from the outcrop in the road on top of a hill, three or four miles northeast of Laceyville, in Auburn township, Susquehanna co., Pa. Andrew Sherwood, collector. 1871.

570 Chemung beds. Lindley, Steuben co. Horizon below the conglomerate. Andrew Sherwood, collector. 1871.

570a Chemung beds. From below the Millstone grit. Halfway between Bradford and Farmers Valley, McKean co., Pa. Andrew Sherwood, collector. 1871.

570b Chemung beds. Specimens of Dictyosponges. Bath, Steuben co. Andrew Sherwood, collector. 1871.

570c Chemung beds. Specimens from Bath. Andrew Sherwood, collector. 1871.

570d Chemung beds. Specimens from Tioga, Tioga co., Pa. Andrew Sherwood, collector. 1871.

571 Upper Chemung beds. Specimens from below the conglomerate at Tioga, Tioga co., Pa. Andrew Sherwood, collector. 1871.

571a Catskill beds. Specimens from Tioga, Pa. Andrew Sherwood, collector. 1871.

572 Chemung beds. Specimens from Erwin Center, Steuben co. Andrew Sherwood, collector. 1871.

573 Chemung beds. Fossils from bank of the Chemung river, between Corning and Elmira. Andrew Sherwood, collector. 1871.

574 Chemung beds. Fossils from Corning and Painted Post. Andrew Sherwood, collector. 1871.

575 Chemung beds. Fossils from Chemung river between Elmira and Waverly. Andrew Sherwood, collector. 1871.

575a Chemung beds. Fish remains from Smithfield, Bradford co., Pa. Andrew Sherwood, collector. 1871.

575c Chemung beds. Fossils from between Ulster and Towanda, Pa. Andrew Sherwood, collector. 1871.

575d Chemung beds. Fossils from the so-called silver mines, Bradford co., Pa. Andrew Sherwood, collector. 1871.

576 Chemung beds. Fossils from strata at the mouth of Wysox creek, Wysox township, Bradford co., Pa. Andrew Sherwood, collector. 1871.

577 Chemung beds. Fossils from the Chemung at Vestal, Broome co. Andrew Sherwood, collector. 1871.

578 Chemung beds. Two miles south of Nichols, Tioga co. Andrew Sherwood, collector. 1871.

578a Ithaca beds (Chemung group, old record). From Oneonta, Otsego co. Andrew Sherwood, collector. 1871.

578c Ithaca beds (Chemung group, old record). Two miles west of North New Berlin, Chenango co. Andrew Sherwood, collector. 1871.

578d Chemung beds. Specimens from Binghamton township, Broome co. Andrew Sherwood, collector. 1871.

578e Chemung beds. From the north part of Rome township, Bradford co., Pa. Andrew Sherwood, collector. 1871.

579 Catskill beds. Specimens from Mansfield, Pa. Andrew Sherwood, collector. 1871.

580 Chemung beds. Specimens from Mansfield, Pa. Andrew Sherwood, collector. 1871.

581 Upper Chemung beds. Specimens from a bed of iron ore at Austinville, Columbia township, Bradford co., Pa. Andrew Sherwood, collector. 1871.

582 Chemung beds. From near the township line west of Smithfield, Bradford co., Pa. Andrew Sherwood, collector. 1871.

582a Chemung beds. From Smithfield, Pa. Andrew Sherwood, collector. 1871.

582c Chemung beds. Specimens from localities between Mitchels and Columbia Crossroads, Pa. A. Sherwood, collector. 1871.

583 Chemung beds. Specimens from Columbia township, Bradford co., Pa. A. Sherwood, collector. 1871.

584 Chemung beds. Specimens from Roseville, Tioga co., Pa. Andrew Sherwood, collector. 1871.

584a Chemung beds. Ulster township, Bradford co., Pa. (near Hemlock run). A. Sherwood, collector. 1871.

585 Chemung beds. Specimens on Cook's creek, Lindley township, Steuben co. Horizon below conglomerate. Andrew Sherwood, collector. 1871.

586 Upper Chemung beds. Specimens from Mansfield, Pa. Andrew Sherwood, collector. 1871.

587 Upper Chemung beds. Specimens from Charleston township, Tioga co., Pa. A. Sherwood, collector. 1871.

588 Upper Chemung beds. Sullivan township, Tioga co., Pa. Andrew Sherwood, collector. 1871.

589 Chemung beds. Specimens from two miles west of Lawrenceville village, Tioga co., Pa., in an excavation for a railroad. Horizon supposed to be below the conglomerate. Andrew Sherwood, collector. 1871.

590 Upper Chemung beds. Specimens from a loose mass of rock taken from the excavation for a railroad two miles west of Lawrenceville, Pa. The rock is supposed to have come from the top of the mountain one or two miles to the north, where there is said to be more of the same kind. Horizon unknown, but supposed to be near the Chemung conglomerate. Andrew Sherwood, collector. 1871.

591 Chemung beds. Gorton's quarry, Corning. Horizon below the conglomerate. Andrew Sherwood, collector. 1871.

592 Chemung beds. Gorton's quarry, Corning. Horizon below the conglomerate. Andrew Sherwood, collector. 1871.

593 Chemung beds. Specimens from lands of Thomas Knapp, two miles west of Lawrenceville, Pa. Horizon 500 feet below top of Chemung. Andrew Sherwood, collector. 1871.

594 Chemung beds. Morgan's creek, Lindley township, Steuben co. Horizon below the conglomerate. Andrew Sherwood, collector. 1871.

595 Chemung beds. From the farm of Jacob Zahn, in northern border of Lindley township, Steuben co. Horizon supposed to be the same as the Chemung conglomerate. Andrew Sherwood, collector. 1871.

596 Chemung beds. Specimens representing the physical character of the rocks on a small creek on lands of Thomas Knapp, two miles west of Lawrenceville, Pa. Andrew Sherwood, collector. 1871.

597 Chemung beds. Vespertine. Specimens representing the physical character of the rocks (supposed to be Vespertine) on the Norway ridge in the south border of Woodhull township, Steuben co., and on lands of Leander Clark and of Mr McCasslin. They are mostly surface rocks, as the solid bed comes to the surface in but few places. The following is a key to the number on the specimens. Andrew Sherwood, collector. 1871.

1 From loose rocks on top of hill
2 From loose rocks near top of hill
3 From loose rocks 50 or 60 feet below top of hill
4 From loose rocks 70 feet below top of hill
5 From loose rocks 80 feet below top of hill
6 From an outcrop of solid rock, 100 feet below top of hill
7 From an outcrop of solid rock, 100 to 150 feet below top of hill
8 From loose rocks 200 feet below top of hill

598 Ithaca beds (Hamilton group, old record). On a small creek, one mile north of Gilbertsville, Otsego co. Andrew Sherwood, collector. 1871.

599 Ithaca beds (Chemung group, old record). Two miles above Chenango Forks on the road to Norwich. Andrew Sherwood, collector. 1871.

599a Chemung beds. Miscellaneous specimens from Steuben, Allegany and Cattaraugus co., N. Y., and McKean and Potter co., Pa. A. Sherwood, collector. 1871.

The numbers 600–13 (in orange tickets) designate the geological formations and localities of a collection of fossils purchased of John Gebhard jr, in 1872. Those marked *Pickett collection* were purchased of Mr Pickett, late of Rochester, and those marked *Simms collection* were purchased of Jeptha Simms, late of Fort Plain. These have all been incorporated into the general collection, though each specimen is marked with a printed ticket bearing the name of the original owner. Other numbers, to 847 inclusive, record various miscellaneous collections which had accumulated in the state cabinet previous to 1866.

600 Hudson river beds. Schoharie co.

601 Niagara beds (Coralline limestone, old record). Schoharie co.

601a Waterlime beds. Schoharie co.

602 Tentaculite limestone. Schoharie co.

603 Pentamerus limestone. Schoharie co.

604 Shaly limestone. Schoharie co.

605 Becraft limestone. Schoharie co.

606 Oriskany sandstone. Schoharie co.

607 Schoharie grit. Schoharie co.

608 Onondaga limestone. Schoharie co.

609 Onondaga limestone. Schoharie co.

610 Marcellus shale. Schoharie co.

611 Hamilton beds. Schoharie co.

612 Portage beds. Schoharie co.

613 Chemung beds. Schoharie co.

614 Helderbergian group. Gebhard collection, old and new, and miscellaneous collections of James Hall and assistants.

615 Oriskany sandstone. Seneca and Cayuga co. Pickett collections.

616 Helderbergian limestone. Schoharie co. Simms collection.

617 Ulsterian group. Schoharie co. Gebhard collection (1872).

618 Hamilton beds. Schoharie co. Simms collection.

619 Trenton limestone. Simms collection.

620 Trenton limestone. Herkimer co. Simms collection.

621 Trenton limestone. Fort Plain. Simms collections.

622 Trenton limestone. Fonda. Simms collection.

623 Trenton limestone. Trenton Falls. Simms collection.

624 Utica slate. Herkimer and Montgomery co. Simms collection.

625 Niagara beds. Lockport. Simms collection.

The following are miscellaneous collections of John Gebhard (old collection purchased previous to 1872) and of Prof. James Hall and assistants.

626 Trenton limestone.
627 Hudson river beds.
628 Hudson river beds.
629 Medina sandstone.
630 Clinton beds.
631 Niagara beds.
632 Coralline limestone. Schoharie.
633 Salina beds (Onondaga salt group, old record). Schoharie.
634 Tentaculite limestone. Schoharie.
635 Pentamerus limestone. Schoharie.
636 Shaly limestone. Schoharie.
637 Becraft limestone. Schoharie co.
638 Oriskany sandstone. Schoharie co.
639 Ulsterian group. Schoharie co.
640 Hamilton beds. Fragments of Psaronius and other fossil plants from Gilboa.
641 Portage beds.
642 Chemung beds.
643 Hudson river beds. Cincinnati, O. Pickett collection.
644 Hudson river beds. Oswego co. Pickett collection.
645 Clinton beds. Rochester. Pickett collection.
646 Niagara beds. Rochester. Pickett collection.
648 Hamilton beds. Principally Ontario and Livingston co. Pickett collection.
649 Onondaga limestone. Corals from the neighborhood of Caledonia. Pickett collection.
650 Carbonic and other fossils from Missouri. C. Veatch, in exchange. 1873.
651 Hudson river beds. Graptolites. South side of Mohawk river, west of and near Amsterdam. James Hall, collector. 1873.
652 Laurentian gneiss. Eozoon canadense. Chelmsford, Mass. Prof. L. B. Burbank.
653 Hamilton beds. Richmondville. Gebhard collection.
654 Trenton limestone. Gebhard collection. 1872.

655 Hudson river beds. Western states. Gebhard collection.
656 Medina sandstone. Gebhard collection.
657 Clinton beds. Gebhard collection.
658 Niagara beds. Gebhard collection.
659 Onondaga limestone (Upper Helderberg limestone, old record). Williamsville, Erie co. James Hall, collector.
660 Marcellus shale and Agoniatites limestone. Manlius, Onondaga co. James Hall, collector.
661 Birdseye limestone. Phytopsis tubulosum. Gebhard collection.
663 Calcites. Calcareous tufa. Chittenango.
664 Onondaga limestone. Falls of the Ohio. S. S. Lyon, collector.
665 Coal measures. Edmondson co., Kentucky. S. S. Lyon, collector.
666 Salina beds (Onondaga salt group, old record). Manlius.
667 Waterlime beds. Cobleskill.
668 Niagara beds. Lockport.
669 Laurentian gneiss. Rossie.
670 Calcite. Ball's and other caves. Schoharie and vicinity.
671 Franklinite. New Jersey.
672 Sulfate Baryta. Pillarpoint, opposite Sacket Harbor.
673 Sulfate Baryta. Cheshire, Ct.

The specimens recorded below, under the numbers 674 to 680, are from collections made by Prof. James Hall previous to 1855.

674 Hamilton beds. Summit, Schoharie co.
675 Tully limestone. Tully.
676 Hamilton beds. Pavilion, Genesee co.
677 Hamilton beds. Seneca lake.
678 Hamilton beds. Genesee co.
679 Hamilton beds. Lake Erie shore to Darien.
680 Hamilton beds. York, Livingston co.
690 Trenton limestone. Emmons collection.
691 Utica slate. Gebhard collection.
692 ? ? Lawrence brook, N. J.
693 Gypsum. Alabaster bay, Lake Michigan.

694 Stalactitic gypsum. Mammoth cave, Ky.

695 Limestones of coral reefs. Bermuda.

696 Salina beds (Onondaga salt group, old record). Onondaga co.

697 Clay stones. West Albany.

698 Minerals. Rutland, Vt.

699 Serpentine. Hoboken, N. J.

700 Potsdam sandstone. St Croix falls, Minnesota. 1865.

701 Chazy limestone. Chazy.

The numbers 700 and 701 remain in red or crimson tickets, as in the original collection of Prof. Hall.

702 Miscellaneous minerals. Orange co.

703 Quartz crystals and iron ore. Herkimer co.

704 Rose quartz and muscovite. Acworth, N. H.

705 Miscellaneous minerals. Hudson river valley.

706 Drusy quartz and chrysoprase. Newfane, Vt.

707 Miscellaneous minerals. Berkshire co., Mass.

708 Chert. Sprakers basin.

709 Flints. Chalk formation. England.

710 Trenton limestone. Bay Quinta, Can. James Hall, collector.

711 Trenton limestone. Petrie's quarry, Littlefalls. J. W. Hall, collector.

712 Trenton limestone. Harris's quarry, near Middleville. J. W. Hall, collector.

713 Trenton limestone. Stony brook, two miles south of Middleville. J. W. Hall, collector.

714 Trenton limestone. Moltauner creek, near Middleville. J. W. Hall, collector.

715 Trenton limestone. Old city. J. W. Hall, collector.

716 Trenton limestone. Old city (brook on Phillips' farm) J. W. Hall, collector.

717 Trenton limestone. West Canada creek, two miles north of Poland. J. W. Hall, collector.

718 Trenton limestone. Gravesville, two miles south of Trenton Falls. J. W. Hall, collector.

719 Trenton limestone. Rathbun's creek, two miles north of Newport. J. W. Hall, collector.

720 Hudson river beds. Cincinnati, O., and Madison, Ind.

721 Trenton limestone. Smiths, White creek, Herkimer co. J. W. Hall, collector.

722 Trenton limestone. Shed brook, two miles south of Newport. J. W. Hall, collector.

730 Niagara beds. Lockport. James Hall, collector.

821 Indian relics. Gebhard collection.

822 Fossils from the Guelph beds at Elora, Ontario. From David Boyle.

825 Calcite in various forms. Ball's cave specimens, principally Gebhard collection.

826 Claystones and concretions. Schoharie. Gebhard collection.

835 Clinton beds. Iron pyrites. Schoharie. Gebhard collection of 1872.

836 Minerals of the Simms collection. Mainly without localities.

837 Indian stone implements. Connecticut river valley. Dexter Marsh collection.

838 Indian stone implements. Loudonville, Albany co. F. E. Aspinwall, collector.

845 Cretaceous fossils. Mt Lebanon, Syria. Henry A. Riley, collector. 1871.

846 Ores and minerals. From various localities.

847 Minerals of unknown or undetermined localities.

877 Marcellus shale. Coxs falls near Cherry Valley, and falls one and a half miles east of Cherry Valley. J. W. Hall, collector. 1877.

878 Onondaga limestone. Corals, etc. Along railroad at Cherry Valley. J. W. Hall, collector. 1877.

879 Onondaga limestone. Corals. Thompsons lake and vicinity. J. W. Hall, collector. 1877.

880 Oriskany sandstone and Onondaga limestone. Miscellaneous. Knox and vicinity. J. W. Hall, collector. 1877.

881 Ulsterian and Helderbergian groups. Corals, etc. Schoharie. J. W. Hall, collector. 1877.

882 Helderbergian group. Quarries near Cobleskill. J. W. Hall, collector. 1877.

883 Onondaga limestone. Sharon and vicinity. J. W. Hall, collector. 1877.

884 Onondaga limestone. Sharon and vicinity. J. W. Hall, collector. 1877.

885 Helderbergian group. Corals. Sharon Springs. J. W. Hall, collector. 1877.

886 Railroad cut, four miles northeast of Cherry Valley. J. W. Hall, collector. 1877.

887 Hamilton beds. Springfield, Otsego co. J. W. Hall, collector. 1877.

888 Onondaga limestone group. Richfield Springs and vicinity. J. W. Hall, collector. 1877.

889 Hamilton beds. Lawyersville, two miles west of Cobleskill. J. W. Hall, collector. 1877.

890 Hamilton beds. Hartwick and south of Cooperstown. J. W. Hall, collector. 1877.

891 Hamilton beds. West of Port Jervis. J. W. Hall, collector. 1877.

892 Helderbergian group. Two miles east and south of Port Jervis. J. W. Hall, collector. 1877.

893 Helderbergian group. Nearpass quarry, four miles south of Port Jervis. J. W. Hall, collector, 1877.

894 Helderbergian group. Trilobites, Nearpass quarry, one half mile northwest of Port Jervis. J. W. Hall, collector. 1877.

895 Hamilton beds. Delphi and vicinity. J. W. Hall, collector. 1877.

900 Minerals. Schoharie. Presented by the Schoharie academy, August 1881, in return for a collection of fossils sent to the school.

1001 Laurentian gneiss. Littlefalls. C. Van Deloo, collector. 1882.

1080 Cambrian (breccia). From top of hill back of Troy. J. C. Smock and C. E. Beecher, collectors. 1885.

1081 Cambrian. Troy. C. Schuchert, donor. 1893.

1082 Cambrian. Sponges from Little Metis, Can. Sir J. W. Dawson, donor. 1889.

1083 Potsdam sandstone. Geological section at Saratoga Springs. C. D. Walcott, collector.

1092 Laurentian gneiss. Lone rock point and Shelburne point, near Burlington, Vt. J. W. Hall, collector. 1879.

1093 Laurentian gneiss. Split rock point (Old iron mine), Lake Champlain. J. W. Hall, collector. 1879.

1094 Trenton limestone. North point of Button bay, north of Button island, Vt., opposite Westport. J. W. Hall, collector. 1879.

1095 Potsdam sandstone. Potsdam. From the Cathedral of the Immaculate Conception, Albany.

1096 Potsdam sandstone. Lingulas and trilobites from Ausable chasm. Jacob Van Deloo, collector. 1890.

1097 Potsdam sandstone. Black creek, one mile above Sterlingville, Jefferson co. C. J. Sarle, collector. 1896.

1100 Cambrian. Olenellus quartzite. Stissing mountain, Dutchess co. J. M. Clarke, collector. 1888.

1101 Cambrian. Ratcliff's mills, Hanford brook, New Brunswick. James Hall, donor. 1892.

1102 Cambrian. Swanton falls; strata exposed at foot of falls on left side of river. C. Rominger, collector. 1888.

1103 Chazy limestone. From a boulder. Sharon Springs. J. W. Hall, collector. 1880.

1104 Black river limestone. Lake Champlain. J. W. Hall, collector. 1879.

1105 Calciferous sandstone? Lake side of Shelburne point, two and one half miles north of Juniper lighthouse, Lake Champlain. J. W. Hall, collector. 1879.

1106 Calciferous sandstone. Quarry three miles west of Saratoga Springs near large limekiln and **Stromatopora** beds. C. D. Walcott and C. Van Deloo, collectors. 1877.

1107 Calciferous sandstone. Appletree point, north of Burlington, Vt. J. W. Hall, collector. 1879.

1108 Calciferous sandstone. Essex; lake shore. J. W. Hall, collector. 1879.

1109 Black river limestone. Button island, Lake Champlain, Vt., opposite Westport. J. W. Hall, collector. 1879.

1110 Trenton limestone? Bay south of Wing's point, Vt., opposite Essex. J. W. Hall, collector. 1879.

1111 Chazy limestone. Point and bay east side of Lake Champlain, north of Fort Cassin. J. W. Hall, collector. 1879.

1112 Trenton and Chazy limestones. Basin harbor, east side of Lake Champlain. J. W. Hall, collector. 1879.

1112a Calciferous sandstone.

1113 Chazy limestone. From quarry one mile east of Keeseville on Chesterfield street. J. Van Deloo, collector. 1890.

1114 Chazy limestone. From yard, side of Mrs Brewer's residence, corner of Chesterfield and Main st., Keeseville. From same locality as 1113. J. Van Deloo, collector. 1890.

1115 Chazy limestone. Ferrisburg, Vt. H. M. Seeley, donor. 1892.

1116 Chazy limestone. Sawyer's bay, Vt. H. M. Seeley, donor. 1892.

1117 Chazy limestone. Leicester, Vt. H. M. Seeley, donor. 1892.

1117a Chazy limestone. Chazy. C. J. Sarle, collector. 1897.

1118 Calciferous sandstone. On Adirondack railroad, one half-mile northwest of Saratoga. C. Schuchert, donor. 1893.

1119 Calciferous sandstone. Valcour island. C. J. Sarle, collector. 1897.

1120 Middle Calciferous sandstone. East Beekmantown. C. J. Sarle, collector. 1897.

1121 Calciferous sandstone. Bluff point, Lake Champlain. C. J. Sarle, collector. 1897.

1122 Chazy limestone. Specimens presented by G. H. Perkins, Burlington, Vt. 1899. See localities on specimens.

1123 Chazy, Calciferous and Trenton limestones from Clinton co.
- 1123 Locality unknown
- 1123a Champlain township
- 1123b Chazy township
- 1123c Beekmantown (Calciferous)
- 1123d Plattsburg
- 1123e Peru township (Calciferous)
- 1123f Trenton from Clinton co.

H. P. Cushing, collector. 1894.

1131 Calciferous sandstone. Three miles west of Saratoga Springs, from along line of outcrop of three miles. All from same ledge extending through different quarries along the line. C. D. Walcott, collector. 1878.

1133 Calciferous sandstone. Two to four miles west of Pattersonville, on the West Shore railroad, near the Erie canal. C. Van Deloo, collector. 1882.

1134 Calciferous sandstone. Littlefalls. C. Van Deloo, collector. 1882.

1135 Birdseye limestone. Two and three quarter miles west of Saratoga Springs. C. D. Walcott and C. Van Deloo, collectors. 1877.

1136 Birdseye limestone. Fort Cassin, Vt. C. Rominger, collector. 1888.

1137 Birdseye limestone. Fort Cassin, Vt.; lowest strata. C. Rominger, collector. 1888.

1138 Birdseye limestone. Four miles south of Rouse Point on Mr King's farm. C. Rominger, collector. 1888.

1139 Trenton limestone. Three miles west of Saratoga Springs. Quarries of Prince Wing. C. D. Walcott and C. Van Deloo, collectors. 1877.

1140 Trenton limestone. Leyden, Lewis co. Sugar river below the falls. H. F. Hickok, donor. 1872.

1141 Trenton limestone. Whetstone creek, Martinsburg, Lewis co. H. F. Hickok, donor. 1872.

1142 Trenton limestone. Moose creek, Leyden, Lewis co. H. F. Hickok, donor. 1872.

1143 Trenton limestone. Hubbard's creek, Leyden, Lewis co. H. F. Hickok, donor. 1872.

1144 Trenton limestone. Sprakers Basin.

1145 Trenton limestone.

1146 Trenton limestone. Carlton island. Clarke collection purchased. 1889.

1147 Trenton limestone. Highgate Springs, Vt. West of hotel; lowest strata near lake shore. C. Rominger, collector. 1888.

1148 Trenton? Highgate Springs, Vt. East of hotel. C. Rominger, collector. 1888.

1149 Birdseye? limestone. Isle Lamotte, Vt. C. Rominger, collector. 1888.

1150 Trenton limestone. Chazy. C. Rominger, collector. 1888.

1151 Trenton limestone. Boulder on shore of Isle Lamotte, Vt. C. Rominger, collector. 1888.

1152 Black river and Birdseye limestone. Chazy quarries, Chazy. C. Rominger, collector. 1888.

1153 Trenton limestone. Lighthouse point near Port Henry. C. Rominger, collector. 1888.

1154 Trenton limestone. Rawlin's mills, four miles southwest of Saratoga Springs. C. Rominger, collector. 1888.

1155 Limestone overlying Potsdam sandstone. Skeen mountain, Whitehall. C. Rominger, collector. 1888.

1156 Limestone on railroad from Whitehall to Rutland, Vt.; beneath 2d slate belt. C. Rominger, collector. 1888.

1157 Limestone and underlying slates. Smiths Basin. C. Rominger, collector. 1888.

1158 Lower strata at Port Henry, with Maclurea. C. Rominger, collector. 1888.

1159 Slates overlying 1156. C. Rominger, collector. 1888.

1160 Slates underlying 1156. C. Rominger, collector. 1888.

1161 Black river limestone. From Buck's quarry, Poland, Herkimer co. Purchased of W. P. Rust. July 1890.

1162 Black river limestone. Alder creek near Booneville. Purchased of W. P. Rust. July 1890.

1164 Trenton limestone (middle). From the diggings owned by W. P. Rust and C. D. Walcott, in Herkimer co., near Trenton Falls. Purchased of W. P. Rust. July 1890.

1165 Trenton shale. One and one half miles east of Holland Patent, Oneida co. Purchased of W. P. Rust. July 1890.

1166 Calciferous limestone. Fort Cassin, Vt. H. M. Seeley, donor. 1892.

1167 Calciferous limestone. Providence island, Vt. H. M. Seeley, donor. 1892.

1168 Calciferous limestone. Shoreham, Vt. H. M. Seely, donor. 1892.

1169 Calciferous limestone. Beekmantown. H. M. Seeley, donor. 1892.

1170 Trenton limestone? Lower Siluric). Fish remains. Cañon City, Col. E. H. Raymour, donor. 1892.

1171 Upper Trenton limestone. Dam, Sandyhill. C. Schuchert, donor. 1893.

1172 Trenton limestone. Sugar loaf on Rysedorf hill back of East Albany (Rensselaer). C. Schuchert, donor. 1893.

1173 Trenton (Cumberland head slates). Cumberland head. C. J. Sarle, collector. 1897.

1174 Trenton and Black river limestones. From localities near Ottawa, Can. See labels in boxes and vials. W. R. Billings, donor. 1899.

1227 Utica? (Hudson river?) Sandy shales with graptolites. Northwestern part of Chapman plantation, Aroostook co., Me. Olaf O. Nylander, exchange. 1899.

1228 Utica slate. Bakers falls, Sandyhill. C. Schuchert, donor. 1893.

1229 Hudson river slates. Mount Moreno, one and one half miles southwest of Hudson, on Bay road. Martin Sheehy and W. F. Cooper, collectors. 1892.

1230 Utica slate. Near Ottawa, Canada. Purchased of W. P. Rust. July 1890.

1231 Utica slate. Holland Patent. Purchased of W. P. Rust. July 1890.

1232 Hudson river shales (Lorraine). Near Rome; collected by C. Valient. Purchased of W. P. Rust. July 1890.

1233 Hudson river sandstones (Lorraine). Erratic blocks, from towns of Trenton and Russia. Purchased of W. P. Rust. July 1890.

1234 Hudson river shales exposed near the bridge at Swanton village, Vt. C. Rominger, collector. 1888.

1235 Hudson river beds. Dubuque co., Iowa. J. T. Abbott, Manchester, Ia., exchange. February 1887.

1236 Hudson river slates (Graptolites). Two miles below Westpark, Ulster co., along West Shore railroad. James Hall, collector. 1886.

1237 Hudson river slates (Graptolites). Van Wie's point, below Albany; from cutting of West Shore railroad. C. Van Deloo, collector. 1883.

1238 Hudson river slates (Graptolites). Kenwood, Albany co. R. P. Whitefield, C. Van Deloo and others, collectors.

1239 Utica slate. Cold spring, seven miles east of Littlefalls. C. Van Deloo, collector. 1880.

1240 Hudson river beds. Drift rock in Genesee and Erie co. C. D. Walcott and C. Van Deloo, collectors. 1877.

1241 Hudson river beds. Button island, Vt.; Lake Champlain. J. W. Hall, collector. 1879.

1242 Utica slate. Tivoli lake, Albany. J. W. Hall and C. E. Beecher, collectors. 1879.

1243 Utica slate. Tivoli lake, Albany. C. Van Deloo and C. E. Beecher, collectors. 1880.

1244 Utica slate. Whetstone gulf, Martinsburg, Lewis co. H. F. Hickok, donor. 1872.

1245 Utica slate. Sugar river above the falls, Leyden, Lewis co. H. F. Hickok, donor. 1872.

1246 Utica slate. Holland Patent, Oneida co. Charles Haskell, exchange and purchase. 1881.

1247 Utica slate. Sprakers Basin.

1247a Utica slate. Saranac river, near Plattsburg. C. J. Sarle, collector. 1897.

1247b Utica slate. North point near Rouse Point. C. J. Sarle, collector. 1897.

1248 Utica slate. Holland Patent. Rev. W. H. Dean, Mechanicville, donor. 1881.

1249 Utica slate. Holland Patent. Charles Haskell, purchase. 1881.

1250 Utica slate. One to three miles beyond "Two Mile house" near Schenectady, on West Shore railroad. C. Van Deloo, collector. 1882.

1251 Hudson river shales. East shore of Saratoga lake. C. D. Walcott and C. Van Deloo, collectors.

1252 Hudson river slates. Chimmey point gulf, Martinsburg. H. F. Hickok, donor. 1872.

1253 Clinton beds (Blue shales and iron ores). Clinton near Utica. George B. Simpson, collector. 1873.

1253a Clinton shales. Buell avenue, Rochester. F. B. Loomis, Spencerport, donor.

1254 Niagara beds. Hamilton, Ontario. C. D. Walcott, collector.

1255 Clinton sandstone. Hamilton, Ontario. C. D. Walcott, collector.

1256 Clinton beds. Hamilton, Ontario. C. D. Walcott, collector. 1878

1256a Clinton (Niagara ?) beds. Castlehill, Aroostock co., Me. O. O. Nylander, donor. 1899.

1257 Niagara beds. Hamilton, Ontario. W. Waddell, Hamilton, Ontario, donor. 1878.

1258 Clinton beds. Hamilton, Ontario. W. Waddell, Hamilton, Ontario, donor. 1878.

1259 Medina sandstone. Hamilton, Ontario. W. Waddell, Hamilton, Ontario, donor.

1260 Niagara beds. Delaware co., Iowa. J. T. Abbot, Manchester, Ia., exchange. 1887.

1261 Niagara beds. Delphi, Ind. James Hall, collector. 1888.

1262 Niagara beds. Falls of the Ohio. G. K. Greene, purchase. 1888.

1263 Tentaculite limestone east of Clarksville. C. D. Walcott and C. Van Deloo, collectors. 1877.

1263a Helderbergian. Shaly limestone (Bryozoans) two miles east of Clarksville, and near New Salem. C. D. Walcott and C. Van Deloo, collectors. 1877.

1265 Helderbergian group. Clarksville and vicinity. C. D. Walcott and C. Van Deloo, collectors. 1877.

1266 Helderbergian group. Between Carlisle and Sharon. J. W. Hall, collector. 1877.

1267 Helderbergian group. Schoharie public school, exchange. 1881.

1268 Helderbergian group. Schoharie. James Hall, collector. 1886.

1274 Salina beds (Onondaga salt group, old record). Livonia salt shaft, 1084-1092 feet. D. D. Luther, collector. 1892.

1275 Salina beds (Onondaga salt group, old record). Livonia salt shaft, 1100-1116 feet. D. D. Luther, collector. 1892.

1276 Salina beds (Onondaga salt group, old record). Livonia salt shaft, 1101-1210 feet. D. D. Luther, collector. 1892.

1277 Salina beds (Onondaga salt group, old record). Livonia salt shaft, 1120-1144 feet. D. D. Luther, collector. 1892.

1278 Salina beds (Onondaga salt group, old record). Livonia salt shaft, 1150-1212 feet. D. D. Luther, collector. 1892.

1279 Salina beds (Onondaga salt group, old record). Livonia salt shaft, 1200-1280 feet. D. D. Luther, collector. 1892.

1280 Salina beds (Onondaga salt group, old record). Livonia salt shaft, 1235 feet. D. D. Luther, collector. 1892.

1281 Salina beds (Onondaga salt group, old record). Livonia salt shaft, 1200-1250 feet. D. D. Luther, collector. 1892.

1282 Salina beds (Onondaga salt group, old record). Livonia salt shaft, 1280-1290 feet. D. D. Luther, collector. 1892.

1283 Salina beds (Onondaga salt group, old record). Livonia salt shaft, 1285-1328 feet. D. D. Luther, collector. 1892.

1284 Salina beds (Onondaga salt group, old record). Livonia salt shaft, 1328-1342 feet. D. D. Luther, collector. 1892.

1285 Salina beds (Onondaga salt group, old record). Livonia salt shaft, 1342-1350 feet. D. D. Luther, collector. 1892.

1286 Salina beds (Onondaga salt group, old record). Livonia salt shaft, 1320 feet. D. D. Luther, collector. 1892.

1287 Salina beds (Onondaga salt group, old record). Livonia salt shaft, 1356-1365 feet. D. D. Luther, collector. 1892.

1288 Salina beds (Onondaga salt group, old record). Livonia salt shaft, 1380-1390 feet. D. D. Luther, collector. 1892.

1289 Salina beds (Onondaga salt group, old record). Livonia salt shaft, 1356-1378 feet. D. D. Luther, collector. 1892.

1290 Salina beds (Onondaga salt group, old record). Livonia salt shaft, 1374-1380 feet. D. D. Luther, collector. 1892.

1290a Salina beds (Onondaga salt group, old record). Livonia salt shaft, 1390-1403 feet. D. D. Luther, collector. 1892.

1291 Salina beds (Onondaga salt group, old record). Livonia salt shaft, 1403-1404 feet. D. D. Luther, collector. 1892.

1291a Salina beds (Onondaga salt group, old record). Livonia salt shaft, 1403-1410 feet. D. D. Luther, collector. 1892.

1291b Salina beds (Onondaga salt group, old record). Livonia salt shaft, 1410-1452 feet. D. D. Luther, collector. 1892.

1292 Salina beds (Onondaga salt group, old record). Livonia salt shaft, 1425-1432 feet. D. D. Luther, collector. 1892.

1293 Salina beds (Onondaga salt group, old record). Livonia salt shaft, 1300-1400 feet. D. D. Luther, collector. 1892.

1362 Helderbergian? Ashland, Me. Olaf O. Nylander, exchange. 1899.

1363 Helderbergian. Square lake, Me. Olaf O. Nylander, exchange. 1899.

1364 Helderbergian. Catskill creek. George B. Simpson, collector. 1877.

1365 Helderbergian. Clarksville and vicinity. C. D. Walcott and C. Van Deloo, collectors, 1877.

1366 Helderbergian. Clarksville and vicinity. C. D. Walcott and C. Van Deloo, collectors. 1877.

1367 Helderbergian. From drift at Thompsons lake, Albany co. C. Van Deloo, collector. 1877.

1368 Helderbergian. Jerusalem hill, Herkimer co. George B. Simpson, collector. 1873.

1369 Waterlime. Jerusalem hill, Herkimer co. George B. Simpson, collector. 1873.

1370 Helderbergian. In the vicinity of Bradford Allen's and Case Slingerland's near Clarksville. Clarke collection, purchased. 1889.

1371 Helderbergian. Becraft mountain near Hudson. Clarke collection, purchased. 1889.

1372 Helderbergian. Schoharie. Clarke collection, purchased. 1889.

1373 Helderbergian. Square lake, Me. Clarke collection, purchased. 1889.

1374 Waterlime. Livonia salt shaft, 1009-1014 feet. D. D. Luther, collector. 1892.

1375 Waterlime. Livonia salt shaft, 1014-1024 feet. D. D. Luther, collector. 1892.

1376 Waterlime. Livonia salt shaft, 1018-1064 feet. D. D. Luther, collector. 1892.

1377 Waterlime. Livonia salt shaft, 1034-1040 feet. D. D. Luther, collector. 1892.

1378 Waterlime. Livonia salt shaft, 1062-1076 feet. D. D. Luther, collector. 1892.

1379 Waterlime. Livonia salt shaft, 1045 feet. D. D. Luther, collector. 1892.

1380 Waterlime. Phelps, Ontario co. (Flint creek). D. D. Luther, collector. 1895.

1381 Waterlime. Crustacea from Buffalo cement co.'s quarry. Ward and Howell, purchase. 1886.

1382 Waterlime. Crustacea from Buffalo cement co.'s quarry. Lewis J. Bennett, president, donor. 1899.

1389 Helderbergian (Trilobite ledge). Port Jervis. J. M. Dolph, donor.

1390 Oriskany sandstone. Cayuga, Ontario. C. D. Walcott, collector. 1878.

1391 Oriskany sandstone. South Walpole, Ontario. C. D. Walcott, collector. 1878.

1392 Oriskany sandstone. In drift at Thompsons lake, Albany co. C. D. Walcott and C. Van Deloo, collectors. 1878.

1393 Oriskany sandstone. Schoharie. Schoharie public school, exchange. 1881.

1394 Oriskany sandstone. Knox, Albany co. C. Van Deloo, collector. 1882.

1395 Oriskany sandstone. Albany co. Purchased of W. P. Rust. 1890.

1396 Oriskany sandstone. Livonia salt shaft, 1001-1006 feet. D. D. Luther, collector. 1892.

1397 Oriskany sandstone; contact with hydraulic limestone. Livonia salt shaft, 1006-1009 feet. D. D. Luther, collector. 1892.

1398 Oriskany. Chapman plantation on the Presqué Isle, Aroostook co., Me. O. O. Nylander, exchange. 1899.

1410 Lower Devonic. Edmunds hill, Aroostook co., Me. O. O. Nylander, exchange. 1899.

1411 Devonic? (Mapleton sandstone with plant remains). Mapleton, Aroostook co., Me. O. O. Nylander, exchange. 1899.

1412 Schoharie grit. Near Clarksville. Clarke collection, purchased. 1889.

1413 Schoharie grit. Schoharie. Schoharie public school, exchange. 1881.

1413a Esopus grit. Schoharie. Schoharie public school, exchange. 1881.

1414 Schoharie grit. From drift in the vicinity of Thompsons lake, Albany co. C. D. Walcott and C. Van Deloo, collectors.

1415 Schoharie grit. Clarksville. J. W. Hall, collector. 1878.

1442 Onondaga limestone. Leroy. C. D. Walcott, collector. 1878.

1450 Onondaga limestone. Caledonia. Two and one half miles northeast of village on farm of Mr Frick. C. D. Walcott and C. Van Deloo, collectors. 1877.

1451 Onondaga limestone. Caledonia. West and northwest of village. C. D. Walcott and C. Van Deloo, collectors. 1877.

1452 Onondaga limestone. Leroy. Two and one half and three miles east-northeast of village. C. D. Walcott and C. Van Deloo, collectors, 1877; and C. D. Walcott, collector. 1878.

1453 Onondaga limestone. Falkirk, Erie co. C. D. Walcott and C. Van Deloo, collectors. 1877.

1454 Onondaga limestone. Clarence hollow, Erie co. C. D. Walcott and C. Van Deloo, collectors. 1877.

1455 Onondaga limestone. Two and one half to three miles west-northwest of Leroy. C. D. Walcott and C. Van Deloo, collector. 1878.

1456 Onondaga limestone. Williamsville, Erie co. C. D. Walcott, collector. 1878.

1457 Ulsterian group. Thompsons lake, Albany co. C. D. Walcott and C. Van Deloo, collectors.

1458 Onondaga limestone. Littleville, near Avon. C. Van Deloo, collectors. 1878.

1459 Onondaga limestone. Indian Falls, Genesee co. C. D. Walcott and C. Van Deloo, collectors. 1878.

1460 Onondaga limestone. Rama's farm, Point Colborne, Ontario. C. D. Walcott, collector. 1878.

1461 Onondaga limestone. Cayuga, Ontario. C. D. Walcott, collector. 1878.

1462 Onondaga limestone. Falkirk, Erie co. C. D. Walcott and C. Van Deloo, collectors. 1878.

1463 Onondaga limestone. Walpole, Ontario. C. D. Walcott, collector. 1878.

1464 Onondaga limestone. One mile below West Berne (Peoria). Cliff below schoolhouse. J. W. Hall, collector. 1877.

1465 Onondaga limestone. Mumford, Monroe co. C. D. Walcott, collector. 1878.

1466 Onondaga limestone. Clarksville. J. W. Hall, collector. 1877.

1467 Onondaga limestone. Coeymans Hollow. J. W. Hall, collector. 1877.

1468 Onondaga limestone. Neighborhood of Batavia. C. D. Walcott and C. Van Deloo, collectors. 1878.

1469 Onondaga limestone. Kelleys Island, O. C. D. Walcott, collector. 1878.

1470 Onondaga limestone. Schoharie. Schoharie public school, exchange. 1881.

1471 Onondaga limestone. Thompsons lake, Albany co. J. W. Hall, collector. 1877.

1472 Onondaga limestone. Eastman's and Greenslit quarries, Waterville, Oneida co. J. M. Clarke, collector. 1886.

1473 Onondaga limestone. Manlius, Onondaga co. J. M. Clarke, collector. 1886.

1474 Onondaga limestone. Decomposed chert boulders from towns of Canandaigua, East Bloomfield and Farmington, Ontario co. J. M. Clarke, collector. 1886.

1475 Onondaga limestone. On Flint creek at Phelps junction, Ontario co. J. M. Clarke, collector. 1886.

1476 Onondaga limestone. N. Y. C. railroad. One and one half miles west of Clifton Springs, Ontario co. J. M. Clarke, collector. 1886.

1477 Onondaga limestone. Howell's and Holmes's quarries, Limerock, three miles northeast of Leroy. J. M. Clarke, collector. 1886.

1478 Onondaga limestone. Clarence, Erie co. J. M. Clarke, collector. 1886.

1479 Onondaga limestone. Stafford, Genesee co. J. M. Clarke, collector. 1886.

1480 Onondaga limestone. Howell's and Holmes's quarries, Limerock, three miles northeast of Leroy. J. M. Clarke and J. Van Deloo, collectors. 1888.

1481 Onondaga limestone. From boulders of decomposed chert in the drift in the towns of Canandaigua, East and West Bloomfield, and Phelps, Ontario co. Clarke collection, purchased. 1889.

1483 Onondaga limestone. Near Marbletown, Ulster co. Clarke collection, purchased. 1889.

1484 Onondaga limestone. Livonia salt shaft, 467–943 feet. D. D. Luther, collector. 1891.

1485 Onondaga limestone. Livonia salt shaft, 936–954 feet. D. D. Luther, collector. 1891.

1486 Onondaga limestone. Livonia salt shaft, 955–1001 feet. D. D. Luther, collector. 1892.

1487 Onondaga limestone. Limerock, near Leroy. C. J. Sarle, collector. 1897.

1546 Onondaga limestone. Cass co., Ind. E. H. Raymour, donor. 1892.

1547 Onondaga limestone. Waverly, Ind. E. H. Raymour, donor. 1892.

1548 Onondaga limestone. Clarke co., Ind. G. K. Greene, purchase. 1888.

1549 Onondaga limestone. Clarke co., Ind. G. K. Greene, purchase. 1888.

1551 Hamilton beds. East Worcester, Otsego co., Jefferson, Summit and vicinity, Schoharie co. James Hall, collector. 1844.

1552 Marcellus shale. Littleville, near Avon. C. Van Deloo, collector. 1878.

1553 Marcellus shale. One and one half miles east of Alden, on Erie railroad track. C. Van Deloo, collector. 1878.

1554 Marcellus shale. Leroy. C. D. Walcott, collector. 1878.

1555 Marcellus shale (Stafford limestone). 10 feet above Onondaga limestone. Heal's farm, Stafford, Genesee co. J. M. Clarke, collector. 1886.

1556 Marcellus (Stafford) limestone. 10 feet above Onondaga limestone. Heal's farm, Stafford. J. M. Clarke and J. Van Deloo, collectors. 1888.

1557 Marcellus shales. Base of formation. Flint creek, township of Phelps, Ontario co. Clarke collection, purchased. 1889.

1558 Marcellus shale. Mud creek, East Bloomfield. Clarke collection, purchased. 1889.

1560 Hamilton shales. Hill's gulch, Pavilion, Genesee co. C. D. Walcott, collector.

1561 Hamilton shales. York, Livingston co. C. Van Deloo, collector. 1878.

1562 Hamilton shales. Jaycox run, between Geneseo and Avon. C. Van Deloo, collector. 1878.

1563 Hamilton shales. Pratts falls, Onondaga co. J. M. Clarke, collector. 1886.

1564 Hamilton shales. 40 feet below Genesee shales. Tichenor's gully, Canandaigua lake. J. M. Clarke, collector. 1886.

1565 Hamilton shales. 40 feet below Genesee shales, and limestone layer 50 feet above Encrinal limestone. Tichenor's gully, Canandaigua lake. J. M. Clarke and J. Van Deloo, collectors. 1888.

1566 Hamilton shales. Fall brook, four miles east of Canandaigua lake, on the old Geneva road. C. Van Deloo and Martin Sheehy, collectors. 1886.

1567 Hamilton shales and limestones. Centerfield (one mile north on Seaver's creek), Ontario co. J. M. Clarke and J. Van Deloo, collectors. 1888.

1568 Marcellus shales. Mertensia and Padelfords, Ontario co. J. M. Clarke, collector.

1569 Marcellus shales. Contact layer with Corniferous limestone. Flint creek, town of Phelps, Ontario co. J. M. Clarke, collector.

1571 Hamilton beds. Phelps quarries; a few from Stony Post and Alpena, Mich. C. Rominger, collector. 1888.

1571a Hamilton beds, Thunder bay river, Mich. C. Rominger, collector. 1888.

1571b Hamilton beds. Partridge point, Mich. C. Rominger, collector. 1888.

1571c Hamilton beds. Petosky, Mich. C. Rominger, collector. 1888.

1571d Hamilton beds. Long lake, Mich. C. Rominger, collector. 1888.

1571e Hamilton beds. Lime quarries at Petosky, Mich. C. Rominger, collector. 1888.

1572 Hamilton shales. Various localities in the upper part of the group on Canandaigua lake. Clarke collection, purchased. 1889.

1573 Hamilton shales. Tichenor's gully, Canandaigua lake. Clarke collection, purchased. 1889.

1574 Hamilton shales and limestones. Basal layers at Seaver's creek, near Centerfield. Clarke collection, purchased. 1889.

1575 Hamilton shales. Fall brook, Hopewell, Ontario co. Clarke collection, purchased. 1889.

1576 Hamilton shales. Thunder bay, Mich. Clarke collection, purchased. 1889.

1577 Hamilton shales Canandaigua village. Clarke collection, purchased. 1889.

1578 Hamilton shales. Centerfield. J. M. Clarke, collector. 1888.

1599 Ithaca beds (Hamilton group, old record). Plant remains. Gilboa, Schoharie co. Gebhard collection.

1600 Ithaca beds (Hamilton group, old record). Plant remains. Gilboa. James Hall and C. Van Deloo, collectors.

1601 Hamilton beds. Two miles south of Darien Center, on the road to Alden. C. D. Walcott and C. Van Deloo, collectors. 1878.

1602 Hamilton beds. From cutting of Erie railroad track, two miles east of Alden, Erie co. C. D. Walcott and C. Van Deloo, collectors. 1878.

1603 Hamilton beds. Hill's gulch, four miles south of Leroy, Genesee co. C. D. Walcott, collector. 1878.

1604 Hamilton beds. Road from Cooperstown to Hartwick. J. W. Hall, collector. 1877.

1605 Hamilton beds. Top layers of a bluestone quarry near Clarksville. Road between Mud hollow and Reidville. J. W. Hall, collector. 1878.

1606 From the Chemung beds at a quarry near Waverly, Tioga co. Horizon below the conglomerate. Andrew Sherwood, collector. [Probably loose masses of Hamilton rocks. James Hall.]

1607 Hamilton beds. Jefferson, Schoharie co. A. Sherwood, collector. 1873.

1608 Ithaca beds (Hamilton group, old record). From a boulder at Franklin, Delaware co. A. Sherwood, collector. 1873.

1609 Hamilton beds. Near Schoharie. Schoharie public school, exchange. 1881.

1610 Ithaca beds (Hamilton group, old record). Morrisville. J. W. Hall, collector. 1883.

1611 Hamilton beds. Earlville. J. W. Hall, collector. 1883.

1612 Hamilton beds. Eaton. J. W. Hall, collector. 1883.

1613 Hamilton beds. From base of Genesee shales downward. Livonia salt shaft, 225-350 feet. D. D. Luther, collector. 1891.

1614 Hamilton shales. Miscellaneous fossils from upper shales. Livonia salt shaft. D. D. Luther, collector. 1891.

1616 Hamilton shales. Livonia salt shaft, 385-387 feet. D. D. Luther, collector. 1891.

1617 Hamilton shales. Livonia salt shaft, 388-407 feet. D. D. Luther, collector. 1891.

1618 Hamilton shales. Livonia salt shaft, from 407-413 feet. D. D. Luther, collector. 1891.

1619 Hamilton shales. Livonia salt shaft, from 414-428 feet. D. D. Luther, collector. 1891.

1620 Hamilton shales. Livonia salt shaft, from 429-430 feet. D. D. Luther, collector. 1891.

1621 Hamilton shales. Livonia salt shaft, 432 feet. D. D. Luther, collector. 1891.

1622 Hamilton shales. Livonia salt shaft, 433-438 feet. D. D. Luther, collector. 1891.

1623 Hamilton shales. Livonia salt shaft, 430-440 feet. D. D. Luther, collector. 1891.

1624 Hamilton shales. Livonia salt shaft, 440-452 feet. D. D. Luther, collector. 1891.

1625 Hamilton shales. Livonia salt shaft, 447-463 feet. D. D. Luther, collector. 1891.

1626 Hamilton shales. Livonia salt shaft, 463-473 feet. D. D. Luther, collector. 1891.

1627 Hamilton shales. Livonia salt shaft, 468-473 feet. D. D. Luther, collector. 1891.

1628 Hamilton shales. Livonia salt shaft, 473-488 feet. D. D. Luther, collector. 1891.

1629 Hamilton shales. Livonia salt shaft, 473-505 feet. D. D. Luther, collector. 1891.

1630 Hamilton shales. Livonia salt shaft, 505-515 feet. D. D. Luther, collector. 1891.

1631 Hamilton shales. Livonia salt shaft, 516-530 feet. D. D. Luther, collector. 1891.

1632 Hamilton shales. Livonia salt shaft, 530-543 feet. D. D. Luther, collector. 1891.

1633 Hamilton shales. Livonia salt shaft, 543-550 feet. D. D. Luther, collector. 1891.

1634 Hamilton shales. Livonia salt shaft, 550-556 feet. D. D. Luther, collector. 1891.

1635 Hamilton shales. Livonia salt shaft, 556-565 feet. D. D. Luther, collector. 1891.

1636 Hamilton shales. Livonia salt shaft, 565-566 feet. D. D. Luther, collector. 1891.

1637 Hamilton shales. Livonia salt shaft, 567-608 feet. D. D. Luther, collector. 1891.

1638 Hamilton (or Marcellus) shales. Livonia salt shaft, 608-655 feet. D. D. Luther, collector. 1891.

1639 Hamilton (or Marcellus) shales. Livonia salt shaft, 655-750 feet. D. D. Luther, collector. 1891.

1640 Hamilton (or Marcellus) shales. Livonia salt shaft, 750-794 feet. D. D. Luther, collector. 1891.

1641 Marcellus shales. Livonia salt shaft, 795-811 feet. D. D. Luther, collector. 1891.

1642 Marcellus shales. Livonia salt shaft, 812 feet. D. D. Luther, collector. 1891.

1643 Marcellus shales. Livonia salt shaft, 813-820 feet. D. D. Luther, collector. 1891.

1644 Marcellus shales. Livonia salt shaft, 820-822 feet. D. D. Luther, collector. 1891.

1645 Marcellus limestone. Livonia salt shaft, 823, 824 feet. D. D. Luther, collector. 1891.

1646 Marcellus shales. Livonia salt shaft, 825-828 feet. D. D. Luther, collector. 1891.

1647 Marcellus shales. Livonia salt shaft, 828-851 feet. D. D. Luther, collector. 1891.

1648 Marcellus shales. Livonia salt shaft, 851 feet. D. D. Luther, collector. 1891.

1649 Marcellus shales. Livonia salt shaft, 852-854 feet. D. D. Luther, collector. 1891.

1650 Marcellus limestone. Livonia salt shaft, 854, 855 feet. D. D. Luther, collector. 1891.

1651 Marcellus shales. Livonia salt shaft, 856 feet. D. D. Luther, collector. 1891.

1652 Marcellus shales. Livonia salt shaft, 856-862 feet. D. D. Luther, collector. 1891.

1653 Marcellus shales. Livonia salt shaft, 863 feet. D. D. Luther, collector. 1891.

1654 Marcellus shales. Livonia salt shaft, 864-865 feet. D. D. Luther, collector. 1891.

1655 Marcellus shales. Livonia salt shaft, 866 feet. D. D. Luther, collector. 1891.

1656 Marcellus shales. Livonia salt shaft, 820-828 feet. D. D. Luther, collector. 1891.

1657 Marcellus (Stafford) limestone. Flint creek, near Orleans. D. D. Luther, collector. 1898.

1664 Hamilton beds—Upper. Plant remains. Locality lost. Pickett collection.

1665 Hamilton shales. Miscellaneous. Western New York. Pickett collection.

1666 Hamilton shales. Canandaigua lake. J. M. Clarke, collector. 1889.

1667 Hamilton beds. Iowa City, Ia. F. M. Fultz, exchange. 1888.

1700 Genesee shales. Two and three quarters miles south-southwest of Alden, Erie co. Iron bridge mill. C. D. Walcott and C. Van Deloo, collectors. 1878.

1701 Genesee shales. Blacksmith's gully, Bristol, Ontario co. J. M. Clarke and J. Van Deloo, collectors. 1888.

1702 Genesee shales. Canandaigua lake. Clarke collection, purchased. 1889.

1703 Genesee shales. Styliola layer. Bell's gully, Canandaigua lake. Clarke collection, purchased. 1889.

1704 Genesee shales. Livonia salt shaft. D. D. Luther, collector. 1891.

1705 Genesee shales. Pyrite layer at base of black shales. Livonia salt shaft. D. D. Luther, collector. 1891.

1706 Genesee shales. Old state dam at Mount Morris. D. D. Luther, collector. 1891.

1708 Portage beds. At mouth of Mud or Farnham creek, on Lake Erie shore, three miles southwest of Angola. Horizon, 250 feet above Cashaqua shales. D. D. Luther, collector, 1897; J. M. Clarke, collector. 1898.

1709 Portage beds. Big Sister creek, at Angola. Horizon 250 feet above Cashaqua shales. D. D. Luther, collector, 1897; J. M. Clarke, collector. 1898.

1710 Portage beds. Cashaqua shales. North Evans, Eighteen Mile creek. D. D. Luther, collector. 1897.

1711 Portage beds. Attica; Tannery creek above railroad. D. D. Luther, collector. 1896.

1712 Portage beds. Lake Erie shore between Irving and Dunkirk. D. D. Luther, collector. 1897.

1712a Portage beds. Lake Erie; mouth of Little Canadaway creek. D. D. Luther, collector. 1897.

1713 Portage beds. Westfalls; ravine one mile south. Horizon below Portage sandstone. D. D. Luther, collector. 1897.

1714 Portage beds. Cayuga creek, Folsomdale. D. D. Luther, collector. 1897.

1715 Portage beds (or Genesee). Big Buffalo creek at East Elma. D. D. Luther, collector. 1897.

1716 Portage beds. Cayuga creek, Cowlesville. D. D. Luther, collector. 1897.

1717 Portage beds. Varysburg; Westside ravine. D. D. Luther, collector. 1897.

1718 Portage beds. Varysburg; Stony brook. D. D. Luther, collector. 1897.

1718a Portage beds. Sierks station; Tonawanda valley railroad. D. D. Luther, collector. 1897.

1719 Portage beds. Griswold's; along Murder creek. D. D. Luther, collector. 1897.

1720 Portage beds. Cayuga creek at Iron bridge mills. D. D. Luther, collector. 1897.

1721 Portage beds. Johnsons falls, two miles north of Strykersville. D. D. Luther, collector. 1897.

1722 Portage beds. Ravine at Java village. (The upper layers of this section contain some Chemung species.) D. D. Luther, collector. 1897.

1723 Portage beds. Fall brook ravine, Warsaw; 350 feet below Portage sandstone. D. D. Luther, collector. 1897.

1723a Portage beds. High bridge over Silver creek. D. D. Luther, collector. 1897.

1724 Portage beds. Pontiac. D. D. Luther, collector. 1897.

1725 Portage beds. One mile above Mount Morris, Genesee valley. D. D. Luther, collector. 1897.

1726 Portage beds. Smoky hollow, Genesee river. D. D. Luther, collector. 1897.

1727 Portage (Cashaqua shales). Buck run, Genesee valley. D. D. Luther, collector. 1897.

1727* Portage beds. Cattaraugus creek at Versailles. D. D. Luther, collector. 1897.

1727a Portage beds. Gowanda forks of Cattaraugus creek. D. D. Luther, collector. 1897.

1728 Portage (Gardeau) beds. Mouth of Wolf creek, Genesee valley. D. D. Luther, collector. 1897.

1729 Portage beds. Foot of upper Portage falls, Genesee river. D. D. Luther, collector. 1897.

1729a Portage beds. Top of middle Portage falls, Genesee river. D. D. Luther, collector. 1897.

1729b Portage beds. Top of lower Portage falls, Genesee river. D. D. Luther, collector. 1897.

1730 Portage sandstones. Portageville. D. D. Luther, collector. 1897.

1730a Portage sandstones. Dansville. D. D. Luther, collector. 1897.

1731 Portage beds. Gibson's glen, a small ravine two miles southwest of Warsaw. D. D. Luther, collector. 1897.

1732 Portage beds. Forestville; Walnut creek and Terry's ravine. J. M. Clarke and D. D. Luther, collectors. 1898.

1732a Portage beds. Forestville; sandy layers carrying Chemung fauna, Miller's mill. J. M. Clarke and D. D. Luther, collectors. 1898.

1733 Portage beds. Fox's point, Lake Erie, near Angola. J. M. Clarke and D. D. Luther, collectors. 1898.

1733a Portage beds. Along Lake Erie shore, town of Ripley. D. D. Luther, collector. 1897.

1734 Portage shales and sandstones. Correll's point on Lake Erie, near Brocton. J. M. Clarke and D. D. Luther, collectors. 1898.

1734a Portage beds. Lent hill, Cohocton. D. D. Luther, collector. 1896.

1735 Naples shales. Naples, Ontario co. Clarke collection, purchased. 1889.

1736 Naples shales. Cashaqua creek, Livingston co. Clarke collection, purchased. 1889.

1736a Naples shales. Cashaqua creek. D. D. Luther, collector. 1897.

1737 Portage beds. Sandstones at top of Portage fauna, Tannery gully, Naples. D. D. Luther, collector. 1896-98.

1738 Uppermost Portage (Wiscoy shales). Wiscoy creek, Wiscoy above the bridge. D. D. Luther, collector. 1897.

1739 Uppermost Portage beds. Mills Mills, Wiscoy creek. D. D. Luther, collector. 1897.

1740 Portage beds. Ithaca. Pickett collection.

1740a Portage (probably) Ithaca fossils. Young's quarry, one mile northeast of North Java. D. D. Luther, collector. 1897.

1741 Lower Chemung beds. Holland. Horizon not far above Portage sandstone. D. D. Luther, collector. 1897.

1741a Lower Chemung beds. Quarry one and one half miles north of Springville; horizon about same as 1744. D. D. Luther, collector. 1897.

1741b Lower Chemung (or Ithaca) beds. Nunda; at Quarry hill. D. D. Luther, collector. 1897.

1742 Lower Chemung beds. East Koy creek, upper Genesee valley. D. D. Luther, collector. 1897.

1742a Lower Chemung beds. Byersville. D. D. Luther, collector. 1897.

1742b Lower Chemung beds. Zoar (loose). D. D. Luther, collector. 1897.

1743 Lower Chemung beds. Fillmore; east side Genesee river in Scott's ravine. D. D. Luther, collector. 1897.

1743a Lower Chemung beds. Lent hill, McGraine's quarry, Cohocton. D. D. Luther, collector. 1897.

1744 Lower Chemung beds. Long Beards riffs, Genesee river, town of Fillmore. D. D. Luther, collector. 1897.

1744a Lower Chemung beds. Wiscoy creek, one mile north of Pike; Dingman's quarry. D. D. Luther, collector. 1897.

1745 Ithaca or Chemung fossils. Bartlett's rocks, on Genegantslet creek. 100 rods from bridge at Upper Corners, near Greene. F. H. Williams, donor. 1893.

1746 Chemung fossils. Pagebrook road, two and one half miles east of Greene, and 180 feet above Chenango river. F. H. Williams, donor. 1893.

1747 Chemung fossils. West side of Genegantslet creek at H. B. Robinson's farm, Greene, Chenango co. F. H. Williams, Greene, donor. 1893.

1748 Specimens representing sections in Chenango co., from the Ithaca beds upward through the Oneonta sandstone into the Chemung group. Numbered 1748a-v. (See report of state geologist for 1893). J. M. Clarke, collector. 1893.

1749 Chemung (and Ithaca) fossils from Greene and vicinity, Chenango co. F. H. Williams, donor. 1893.

1750 Oneonta sandstone. Day's quarry, three quarters of a mile east of Otego. J. W. Hall and George B. Simpson, collectors. 1870.

1751 Oneonta sandstone (Cypricardites). Five miles from Jefferson, on the road to Gilboa, Schoharie co. A. Sherwood, collector. 1873.

1752 Chemung beds. Mansfield, Tioga co., Pa. A. Sherwood, collector. 1873.

1753 Upper Chemung beds. Iron ore bed. Austinville, Bradford co., Pa. A. Sherwood, collector. 1873.

1754 Chemung beds. Franklin, Delaware co. A Sherwood, collector. 1873.

1755 Chemung beds. Mansfield, Tioga co., Pa. Horizon supposed to be below the conglomerate. A. Sherwood, collector. 1873.

1756 Chemung beds. Charleston township, Tioga co., Pa. A. Sherwood, collector. 1873.

1757 Chemung beds. Tioga, Tioga co., Pa.

1758 Chemung beds (Cypricardites). Richmond's quarry, Chenango co. George B. Simpson, collector. 1868.

1759 Chemung beds. Cortland; and specimens representing a section at Hait's gorge north of Cortland, all numbered and labeled. C. E. Beecher, collector. 1883.

1760 Chemung beds. Warren, Pa. (Specimens also numbered to correspond to numbers on a drawn section of the strata at Warren.) C. E. Beecher, collector. 1884.

1761 Chemung beds. Allegheny springs, Warren co., Pa. C. E. Beecher, collector. 1884.

1762 Chemung beds. Jenks's quarry, Bath, Steuben co. J. W. Hall, C. Van Deloo, M. Sheehy and J. Van Deloo, collectors. 1886.

1763 Chemung beds. Soldiers home, Bath. J. W. Hall, C. Van Deloo, M. Sheehy and J. Van Deloo, collectors. 1886.

1764 Chemung beds. Mountain side west of Bath. J. W. Hall, C. Van Deloo, M. Sheehy and J. Van Deloo, collectors. 1886.

1765 Chemung beds. Quarry at Avoca, Steuben co. J. W. Hall, collector. 1886.

1766 Chemung beds. Castle rock near Wallace, Steuben co. J. W. Hall, C. Van Deloo, M. Sheehy and J. Van Deloo, collectors. 1886.

1767 Chemung beds. Brown hill schoolhouse, four miles west of Wallace. J. W. Hall, C. Van Deloo, M. Sheehy and J. Van Deloo, collectors. 1886.

1768 Chemung beds. Elmira. J. W. Hall, C. Van Deloo, M. Sheehy and J. Van Deloo, collectors. 1886.

1769 Chemung beds. Potter hill schoolhouse, Wayland (town), Steuben co. J. W. Hall, C. Van Deloo, M. Sheehy and J. Van Deloo, collectors. 1886.

1770 Chemung beds. Canadice, near Church. Clarke collection, purchased. 1889.

1771 Chemung beds. Dansville quarries on top of hill east of village. Clarke collection, purchased. 1889.

1772 Chemung beds. Haskinville, Steuben co. Clarke collection, purchased. 1889.

1773 Chemung beds. Warren, Pa. Clarke collection, purchased. 1889.

1774 Chemung beds. Near Block schoolhouse, Prattsburg. D. D. Luther, collector. 1888.

1775 Chemung beds. Ingleside (Riker hollow). Ontario co. D. D. Luther, collector. 1888.

1776 Chemung beds. Haskinville. D. D. Luther, collector. 1888.

1777 Chemung beds. High point, Naples. D. D. Luther, collector. 1888.

1778 Lower Chemung beds. (Dictyophyton.) Ingleside (Rikers hollow). D. D. Luther, collector. 1893.

1779 Chemung beds. Three quarters of a mile northwest of Wellsville. Martin Sheehy and J. Van Deloo, collectors. 1893.

1780 Chemung beds. Near Andover. M. Sheehy and J. Van Deloo, collectors. 1893.

1781 Chemung beds. Miller's quarry, Friendship. M. Sheehy and J. Van Deloo, collectors. 1893.

1782 Chemung beds. Moss creek, near Friendship. M. Sheehy and J. Van Deloo, collectors. 1893.

1783 Chemung beds. Between Friendship and Nile. M. Sheehy and J. Van Deloo, collectors. 1893.

1784 Chemung beds. Almond. M. Sheehy, collector. 1893.

1785 Chemung beds. Almond. M. Sheehy and J. Van Deloo, collectors. 1895.

1786 Chemung beds. Ischua, Cattaraugus co. M. Sheehy and J. Van Deloo, collectors. 1895.

1787 Chemung beds. Wellsville. M. Sheehy and J. Van Deloo, collectors. 1895.

1788 Chemung beds. New Hudson, Allegany co. M. Sheehy and J. Van Deloo, collectors. 1895.

1789 Chemung beds. Cuba, Allegany co. M. Sheehy and J. Van Deloo, collectors. 1895.

1790 Chemung beds. Whitesville, Allegany co. M. Sheehy and J. Van Deloo, collectors. 1895.

1791 Chemung beds. Andover. M. Sheehy and J. Van Deloo, collectors. 1895.

1792 Chemung beds. McHenry valley, Allegany co. M. Sheehy and J. Van Deloo, collectors. 1895.

1793 Chemung beds. Lower beds, in ravine on the farm of Thomas Cotton, one mile north of Avoca (Cotton hill). M. Sheehy and J. Van Deloo, collectors. 1895.

1794 Chemung beds. F. V. R. Stillman, Olean, donor. 1896.

1795 Chemung beds. Rev. James H. McKie, donor. 1896.

1796 Chemung beds. Olean; collection on slope below the reservoir. McKie, Stillman, Hall and others, collectors. 1896.

1797 Chemung beds. Lower beds, in ravine on the farm of Thomas Cotton, one mile north of Avoca (Cotton hill). C. J. Sarle, collector. 1897.

1798 Chemung beds. Crinoids from Cotton hill (Hydnoceras colony), one mile north of Avoca. C. J. Sarle, collector. 1897.

1799 Chemung beds. Crustaceans and Echinoids from Warren, Pa. F. A. Randall, exchange. 1898.

1800 Chemung beds. Canadaway creek, one mile south of Laona. D. D. Luther, collector. 1897.

1801 Chemung beds. Bell creek, town of Ripley, Chautauqua co. D. D. Luther, collector. 1897.

1802 Chemung beds. Near Corning. J. F. Carll, donor. 1899.

1947 Catskill beds. Green shales from Coxton, Pa. David White, donor. 1899.

1948 Catskill beds. Fish remains. Locality not known. Pickett collection.

1949 Catskill beds. Seeley creek, one mile west of Lamb's creek, Tioga co., Pa. A. Sherwood, collector. 1873.

1950 Catskill beds. Seeley creek, one mile east of Lamb's creek, four miles northwest of Mansfield, Pa. A. Sherwood, collector. 1873.

1960 Waverly beds. Warren, Pa. C. E. Beecher, collector. 1884.

1961 Waverly beds. Near Pleasantville, Pa. J. F. Carll, donor. 1899.

1969 Choteau limestone. Sedalia, Mo.

1970 Lower Carbonic (Warsaw group). Spergen hill, Ind. C. D. Walcott and C. Van Deloo, collectors. 1877.

1971 Warsaw limestone. Spergen hill, Ind. Pickett collection.

1972 St Louis beds. Louisville, Ind. G. K. Greene, purchase. 1888.

1973 Keokuk beds. Southern ? Indiana. Pickett collection.

1977 Kinderhook beds. Burlington, Ia. F. M. Fultz, exchange.

1975 Burlington limestone. Mostly crinoids. Burlington, Ia. F. M. Fultz, exchange. 1888.

1976 Burlington limestone. Crinoids. Burlington, Ia. C. R. Keyes, exchange. 1889.

1977 Kinderhook beds. Burlington, Ia. F. M. Fultz, exchange. 1888.

1978 Kinderhook beds. Marshall co., Ia. (Crinoids)

2000 Barren coal measures. Carrollton, O. Clarke collection, purchased. 1889.

2001 Carbonic limestone. Northern Indiana. Pickett collection.

2002 Carboniferous. Missouri? Pickett collection.

2003 Coal measures. Illinois? Pickett collection.

2004 Coal measures. Ohio or Indiana. Pickett collection.

2005 Coal measures. Pennsylvania. Pickett collection.

2006 Coal measures. Pennsylvania. T. E. Van Loon, donor.

2007 Coal measures. Kansas City, Mo., and Lecompton, Kan. Rev. John Bennett, Pittsburg, Kan., exchange. 1899.

2008–2012 Specimens of brachiopods presented by Prof. James M. Safford, Nashville, Tenn. March 1899.

2008 Trenton (Glade) limestone. Nashville, Tenn.

2009 Trenton limestone. Knoxville, Tenn.

2010 Hudson river beds. East Tennessee.

2011 Trenton limestone. East Tennessee.

2012 Coal measures. Tennessee?

2013 Lower Carbonic (Keokuk beds). Crawfordsville, Ind. Dictyosponges. A. S. Tiffany, Davenport, Ia., purchase. 1899.

2014 Lower Carbonic (Waverly). O. Dictyosponge. A. S. Tiffany, purchase. 1899.

2015= 157 round ticket. Clinton beds. Hamilton, Ontario. C. D. Walcott, collector, 1878.

2016= 180 round ticket. Niagara shale. Waldron, Shelby co., Ind. C. D. Walcott and C. Van Deloo, collectors. 1878.

2017= 181 round ticket. Niagara limestone. Charlestown, Clarke co., Ind. C. D. Walcott, collector. 1878.

2018= 182 round ticket. Niagara limestone. Flatrock creek, Shelby co., Ind. C. D. Walcott, collector. 1878.

2019= 183 round ticket. Niagara limestone. Hamilton, Ontario, C. D. Walcott, collector. 1878.

2020= 255 round ticket. Sandstone. Schoharie grit. Pendleton, Madison co., Ind. C. D. Walcott and C. Van Deloo, collectors. 1878.

2021= 278 round ticket. Onondaga limestone. Charlestown, Ind. C. D. Walcott and C. Van Deloo, collectors. 1878.

2022= 278a round ticket. Onondaga limestone. Lexington, Scott co., Ind. C. D. Walcott and C. Van Deloo, collectors. 1878.

2023= 279 round ticket. Onondaga limestone. Falls of the Ohio. Sidney Lyon, exchange.

2024= 279a round ticket. Onondaga limestone. Falls of the Ohio. C. D. Walcott, collector. 1877.

2025= 280 round ticket. Onondaga limestone. South Walpole, Ontario. 4th Con., lot 14. C. D. Walcott, collector. 1878.

2026= 281 round ticket. Onondaga limestone. North Walpole, Ontario. 13th Con., lot 5. C. D. Walcott, collector. 1878.

2027= 282 round ticket. Onondaga limestone. South Cayuga, Ontario. 4th Con., lots 30 and 32. C. D. Walcott, collector. 1878.

2028= 283 round ticket. Onondaga limestone. Pt Colborne and Wainfleet, Ontario. 1st and 2d Con. C. D. Walcott, collector. 1878.

2029= 284 round ticket. Onondaga limestone. Kelleys Island and on Pt Marblehead, O. C. D. Walcott, collector. 1878.

2030= 300 round ticket. Hamilton beds. Falls of the Ohio and southern Indiana. Sidney Lyon, exchange.

2031= 301 round ticket. Hamilton beds. Lexington, Scott co., Ind. C. D. Walcott and C. Van Deloo, collectors. 1878.

2032= 324 round ticket. Hamilton beds. Just beneath the Black slate (Genesee). Lexington, Ind. C. D. Walcott, collector. 1878.

2033= 324a round ticket. Hamilton beds. Beneath the Waterlime. Lexington, Ind. C. D. Walcott, collector. 1878.

2034= 326 round ticket. New Albany black slate (Genesee slate of New York). Lexington, Ind. C. D. Walcott and C. Van Deloo, collectors. 1878.

2035= 350 round ticket. Onondaga limestone. Crawfordsville, Ind. C. D. Walcott, collector. 1877.

2036 Chemung beds. Wellsville. E. B. Hall, donor, 1899.

2037 Chemung beds. Belvidere. E. B. Hall, donor. 1899.

2038 Chemung beds. Owego. E. B. Hall, donor. 1899.

2039 Chemung beds. Scio. E. B. Hall, donor. 1899.

2040 Chemung beds. Olean. E. B. Hall, donor. 1899.

2041 Chemung beds. Brown hill, Cohocton. E. B. Hall, donor. 1899.

2042 Calciferous sandstone. From a glacial boulder at Naples. Contains Ophileta. Specimens of trilobites from a second boulder, more quartzitic, and appearing to be of Cambrian age are marked 2042a. D. D. Luther, collector. 1895.

2043 Medina sandstone. Lewiston. Purchase. 1899.

2044 Helderbergian (Shaly limestone). Catskill. R. W. Jones, donor. 1899.

2045 Helderbergian (Scutella limestone). Catskill. R. W. Jones, donor. 1899.

2046 Hudson river slates. Graptolites, from Mt Moreno, Hudson. R. Ruedemann and M. Sheehy collectors. 1899.

2047 Hudson river slates. Graptolites, etc., from the slate quarry in the Albany rural cemetery, town of Colonie, near the grave of Prof. James Hall. J. M. Clarke and R. Ruedemann, collectors. 1899.

2048 Oneonta sandstone. From the quarry rock, Oxford. The F. G. Clarke bluestone co., donor. 1899.

2049 Oneonta sandstone. Miller quarry (F. G. Clarke Co.), South Oxford (Coventry). The Clarke Co., donor. 1899.

2050 Oriskany sandstone. Yawger's woods, one mile and a half northeast of Union Springs, Cayuga co. J. M. Clarke and D. D. Luther, collectors. 1899.

2051 Clinton shales and chert. From bottom of Erie canal. One mile east of Gasport. J. M. Clarke and D. D. Luther, collectors. 1899.

2052 Limestone lenticles at the top of the Clinton limestone, containing a mixed Clinton and Niagara fauna. Lower part of "Gulf" at Gasport. J. M. Clarke and D. D. Luther, collectors. 1899.

2053 Clinton shales and limestone. From material taken from the bottom of the Erie canal during improvement of 1897; one half mile east of Gasport. J. M. Clarke and D. D. Luther, collectors. 1899.

2054 Niagara shale. Creek bed at Middleport. J. M. Clarke and D. D. Luther, collectors. 1899.

2055 The dark uppermost Siluric limestones above the Eurypterus beds, with Ilionia, Halysites, etc. Frontenac island, Union Springs. J. M. Clarke and D. D. Luther, collectors. 1899.

2056 Waterlime. Cayuga junction and Hills Branch, Cayuga co. J. M. Clarke and D. D. Luther, collectors. 1899.

2057 Limestone lenticles in midst of Clinton limestone. Cut on Rome, Watertown and Ogdensburg railroad, Lewiston. J. M. Clarke and D. D. Luther, collectors. 1899.

2058 Genesee shale and limestone (Styliola). Seneca gully, Canandaigua lake. J. M. Clarke, collector. 1899

2059 Niagara shale. Cut on Rome, Watertown and Ogdensburg railroad, Lewiston. J. M. Clarke and D. D. Luther, collectors. 1899.

2060 Medina sandstone. From bottom of canal; Gasport. J. M. Clarke and D. D. Luther, collectors. 1899.

2061 Black shales with Onchydus, resting on Corniferous limestone. Wood's old quarry, one mile south of Union Springs. J. M. Clarke and D. D. Luther, collectors. 1899.

2062 Marcellus beds. Agoniatites limestone. One half mile southeast of Marcellus, "Dunks hill." D. D. Luther, collector. 1899.

2063 Waterlime. Five feet above Gypsum. Sweet's quarry, Marcellus. D. D. Luther, collector. 1899.

2064 Ithaca beds. Found loose at West Oneonta. J. Van Deloo, collector. 1899.

2065 Calciferous sandstone. Valcour, N. Y. G. Van Ingen and R. Ruedemann, collectors. 1899.

2066 Chazy limestone. Valcour. G. Van Ingen and R. Ruedemann, collectors. 1899.

2067 Lower Devonic fossils. Presque Isle creek, southern part of Chapman plantation, Aroostook co., Me. O. O. Nylander, collector, 1899. Exchange.

2068 Crustacea (Eurypterus, Pterygotus and some lamellibranchs) from a black shale taken out of the Erie canal and lying at or in the base of the Salina formation, in the town of Brighton, near the Pittsford line, Monroe co. C. J. Sarle, Rochester, purchase. 1899.

2069 Agoniatites limestone. Manlius. Prin. C. E. White, Syracuse, donor. 1899.

2070 Onondaga limestone. Le Roy. H. A. Ward, purchase. 1899.

2071 Ithaca beds. One mile south of Colliersville. C. S. Prosser, collector. 1895 ('99).

2072 Hamilton beds. East bank Schoharie creek, three miles above Middleburg. C. S. Prosser, collector. 1897 ('99).

2073 Hamilton beds. Two and one half miles above Boucks falls. C. S. Prosser, collector. 1897 ('99).

2074 Ithaca beds. Below Spragueville, Pa. C. S. Prosser, collector. (1899).

2075 Hamilton beds. Base of Agrippa hill, Albany co. C. S. Prosser, collector. 1897 ('99).

2076 Hamilton beds. Panther creek, two miles below West Fulton. C. S. Prosser, collector. 1897 ('99).

2077 Oneonta (Catskill) sandstone. Near Summit, west of West Durham. C. S. Prosser, collector. 1897 ('99).

2078 Ithaca beds. Road south of Schenevus, below quarry. C. S. Prosser, collector. 1895 ('99).

2079 Ithaca beds. Terrace below Oneonta sandstone on hill between Westkill and Mill brook; North Blenheim. C. S. Prosser, collector. 1895 ('99).

2080 Hamilton beds. Small stream southeast of Urlton, Greene co. C. S. Prosser and R. B. Rowe, collectors. 1897 ('99).

2081 Oneonta sandstone. Franklin. C. S. Prosser, collector. 1895 ('99).

2082 Ithaca beds. Hill three quarters of a mile northeast of East Davenport, Delaware co. C. S. Prosser, collector. 1897 ('99).

2083 Esopus grit (lower part). West Shore railroad just north of Wilbur tunnel, near Kingston. R. Ruedemann, collector. 1899.

2084 Hamilton beds. Railroad track and tollgate below South Cairo, Greene co. C. S. Prosser, collector. 1897 ('99).

2085 (Hamilton beds?) Hill northeast of Houston Corners, east of Breakabeen, Schoharie co. C. S. Prosser, collector. 1897 ('99).

2086 Ithaca beds. Near top of hill one and one half miles south of Worcester, Otsego co. C. S. Prosser, collector. 1897 ('99).

2087 Chemung beds? Brook little above iron railroad bridge on Susquehanna division Delaware & Hudson railroad west of Harpursville, Broome co. C. S. Prosser, collector. 1897 ('99).

2088 Ithaca beds. Above red shales, three miles northeast of Livingstonville, Schoharie co., on branch of Lake brook. C. S. Prosser, collector. 1897 ('99).

2089 Ithaca beds. On road three miles southeast of Breakabeen, Schoharie co. C. S. Prosser, collector. 1897 ('99).

2090 Hamilton beds? From block of greenish sandstone, loose in stream below Gilboa, Schoharie co. C. S. Prosser, collector. 1897 ('99).

2091 Ithaca beds? Shales below falls in West kill at North Blenheim, Schoharie co. C. S. Prosser, collector. 1897 ('99).

2092 Ithaca beds. Hill one half mile northeast of Conesville, Schoharie co. C. S. Prosser, collector. 1895 ('99).

2093 Oneonta sandstone? Hill west of Flat brook, one mile and a half northeast of Gilboa; above the red beds. C. S. Prosser, collector. 1897 ('99).

2094 Hamilton beds. Loose in field one mile northwest of Franklinton, Schoharie co. C. S. Prosser, collector. 1897 ('99).

2095 Chemung beds. Highway, top of hill southwest of Port Crane, Broome co. C. S. Prosser, collector. 1895 ('99).

2096 Hamilton beds. Ledges on hillside east of Mount Vision, Otsego co. C. S. Prosser, collector. 1895 ('99).

2097 Ithaca beds. Shales on hill one mile northwest of Laurens, Otsego co. C. S. Prosser, collector. 1895 ('99).

2098 Hamilton beds. Quarry west side of hill and one half mile west of Dormansville, Albany co. C. S. Prosser, collector. 1895 ('99).

2099 Hamilton beds. Quarry just west of Dormansville. Sandstone with spirifers in shales above quarry stone. C. S. Prosser, collector. 1895 ('99).

2100 Chemung beds. Shales from bank of Bennett's creek just below Bennettsville, Chenango co. C. S. Prosser and W. L. Fisher, collectors. 1897 ('99).

2101 Hamilton beds. A little north of Wawarsing, Ulster co. C. S. Prosser, collector. 1897 ('99).

2102 Hamilton beds. Near top of Braydt hill south of Peoria, Albany co.; above first olive and bluish shales. C. S. Prosser, collector. 1895 ('99).

2103 Chemung beds. From slope below Delaware and Hudson railroad on hill one mile and a half southwest of Port Crane. C. S. Prosser, collector. 1895 ('99).

2104 Chemung beds. From top of Round top, one fourth mile southeast of Franklin, Delaware co. C. S. Prosser, collector. 1895 ('99).

2105 Hamilton beds. Upper part of Fall creek gorge, one and one half miles northwest of Mount Vision, Otsego co. C. S. Prosser, collector. 1895 ('99).

2106 Ithaca beds. On road up hill toward Mackays Corners, one mile east of North Blenheim. C. S. Prosser, collector. 1895 ('99).

2107 Hamilton beds. Shales and sandstones on the west side of Potuck creek, southeast of Gayhead, Greene co. C. S. Prosser, collector. 1897 ('99).

2108 Hamilton beds. Loose slabs on hill northeast of Conesville, Schoharie co. C. S. Prosser, collector. 1895 ('99).

2109 Hamilton beds. From bank of Platte kill, one mile west of Mt Marion station, Ulster co. C. S. Prosser, collector. 1897 ('99).

2110 Hamilton beds. Coarse, arenaceous shales on quarry road north of Summit, Schoharie co. C. S. Prosser, collector. 1897 ('99).

2111 Hamilton beds. Side of road on hill north of Mill brook at North Blenheim. C. S. Prosser, collector. 1897 ('99).

2112 Hamilton beds. On road at crest of ridge east of Gowey pond, three quarters of a mile southwest of Hartwick Seminary. C. S. Prosser, collector. 1895 ('99).

2113 Hamilton beds. From lower exposures in Morehouse brook, Otsego co. C. S. Prosser, collector. 1895 ('99).

2114 Sherburne or Ithaca. From shales between the two falls on Whitney brook, northwest of Maryland. C. S. Prosser, collector. 1895 ('99).

2115 Ithaca beds. From gorge on creek just northwest of Milford Center, Otsego co. C. S. Prosser, collector. 1895 ('99).

2116 Horizon of Tully limestone. From near the foot of hill east of Noblesville (New Lisbon), Otsego co. C. S. Prosser, collector. 1895 ('99).

2117 Ithaca beds. In Whitney brook above the falls, northwest of Maryland. C. S. Prosser, collector. 1895 ('99).

2118 Ithaca beds. From lower falls in Whitney brook, northwest of Maryland. C. S. Prosser, collector. 1895 ('99).

2119 Ithaca beds. On hill about one and one fourth miles southwest of Milford, toward Edson Corners. Transition from Hamilton to Ithaca. C. S. Prosser, collector. 1895 ('99).

2120 Ithaca beds. Outlet of Arnold's lake, Hartwick. C. S. Prosser, collector. 1895 ('99).

2121 Upper Hamilton beds. In Whitney brook, northwest of Maryland. C. S. Prosser, collector. 1895 ('99).

2122 Hamilton beds. At upper end of gorge above old mill one and one half miles north of Milford. C. S. Prosser, collector. 1895 ('99).

2123 Ithaca beds. In quarry by side of road south of Schenevus. C. S. Prosser, collector. 1895 ('99).

2124 Ithaca beds? Shales for 50 feet near top of hill south of Turtle lake creek, well toward top of hill. C. S. Prosser, collector. 1895 ('99).

2125 Ithaca beds. Near top of Texas hill in Pittsfield, two and one half miles southwest of New Berlin. C. S. Prosser, collector. 1895 ('99).

2126 Hamilton beds. Shales on highway south of East Worcester. C. S. Prosser, collector. 1895 ('99).

2127 Hamilton beds. Top of hill south of East Worcester. C. S. Prosser, collector. 1895 ('99).

2128 Hamilton beds. Shales and sandstones on east side of Schoharie river, one mile south of Middleburg. C. S. Prosser, collector. 1895 ('99).

2129 Hamilton beds? Shales at top of hill east of Mount Vision; 365 feet above Otego creek. C. S. Prosser, collector. 1895 ('99).

2130 Upper Hamilton beds? Road corner two miles northeast of Noblesville (New Lisbon). C. S. Prosser, collector. 1895 ('99).

2131 Upper Hamilton beds. Coarse arenaceous shales northeast of Gilberts lake and three miles east of Noblesville (New Lisbon). C. S. Prosser, collector. 1895 ('99).

2132 Ithaca beds. Top of Bowe hill, two and one half miles northeast of Mount Vision and one half mile southwest

of Arnold's lake, Hartwick. C. S. Prosser, collector. 1895 ('99).

2133 Hamilton beds. Shales from road one mile west of Milford. C. S. Prosser, collector. 1895 ('99).

2134 Ithaca beds? From upper falls in Whitney brook, Maryland. C. S. Prosser, collector. 1895 ('99).

2135 Ithaca beds. From highway above falls or Hinman hollow brook, one mile northwest of Milford. C. S. Prosser, collector. 1895 ('99).

2136 Hamilton beds. From side of road two and one half miles northeast of Westville, on the Westford road. C. S. Prosser, collector. 1895 ('99).

2137 Hamilton beds? Loose from east of New Lisbon. C. S. Prosser, collector. 1895 ('99).

2138 Hamilton beds. Shales on run across road southeast of Westville. C. S. Prosser, collector. 1895 ('99).

2139 Hamilton beds. Ledge on east side of Susquehanna river, one mile below Milford. C. S. Prosser, collector. 1895 ('99).

2140 Ithaca beds. Shales and thin sandstone on road one half mile northwest of Laurens. C. S. Prosser, collector. 1895 ('99).

2141 Hamilton beds. Shales and sandstones in creek at corners, one mile east of Breakabeen. C. S. Prosser, collector. 1895 ('99).

2142 Ithaca beds. From ledge well up on high hill on Emmons farm, two miles south of Colliersville, 75 feet below Oneonta sandstone. C. S. Prosser, collector. 1895 ('99).

2143 Ithaca beds. On side of road up hill and by east side of creek, one and one half to two miles east of Oneonta. C. S. Prosser, collector. 1895 ('99).

2144 Ithaca beds. Glen one mile south of Colliersville, above highway. C. S. Prosser, collector. 1895 ('99).

2145 Hamilton beds? On south side of road about two miles east of Summit; not much west of the Eminence road. C. S. Prosser, collector. 1895 ('99).

2146 Hamilton beds. Shales and sandstones in brook a short distance northwest of Franklinton. C. S. Prosser, collector. 1895 ('99).

2147 Marcellus shale. South side of creek at Mill valley, west of Middleburg. C. S. Prosser, collector. 1895 ('99).

2148 Ithaca fauna above the beds. Three miles northeast of Livingstonville, on branch of Lake brook; first excavation. C. S. Prosser, collector. 1895 ('99).

2149 Ithaca beds? From south side of Middle brook at Jefferson. C. S. Prosser, collector. 1895 ('99).

2150 Oneonta sandstone. Red shales and sandstones on hill about one quarter mile north of West Gilboa. C. S. Prosser, collector. 1897 ('99).

2151 Hamilton beds. Shales with fossils one mile up road to southeast, two and one half miles east of Middleburg. C. S. Prosser, collector. 1895 ('99).

2152 Hamilton beds. Shales south of Panther creek, three miles west of West Fulton. C. S. Prosser, collector. 1897 ('99).

2153 Hamilton beds? Blue shales with abundant fossils, by side of road on hill north of Mill brook, North Blenheim. C. S. Prosser, collector. 1897 ('99).

2154 Ithaca beds? On Prospect hill above Rose point, Orange co. C. S. Prosser, collector. 1897 ('99).

2155 Upper Hamilton beds. On road southwest of West Hurley, southeast of Bristol Hill church. C. S. Prosser, collector. 1897 ('99).

2156 Hamilton beds. From shales along creek above Fultonham, toward West Fulton. C. S. Prosser, collector. 1895 ('99).

2157 Ithaca beds. On top of hill two miles south of East Worcester. C. S. Prosser, collector. 1895 ('99).

2158 Chemung? (Ithaca) beds. Loose from side of highway one mile east of Bennettsville. C. S. Prosser and W. L. Fisher, collectors. 1897 ('99).

2159 Ithaca beds. Bluish shales near summit of hill south of West Fulton, following road which turns up the hill two miles below West Fulton. C. S. Prosser, collector. 1897 ('99).

2160 Ithaca beds. Glen one mile south of Colliersville. C. S. Prosser, collector. 1895 ('99).

2161 Ithaca beds. Blue shales along side of creek on hill three and one half miles southwest of West Fulton. C. S. Prosser, collector. 1897 ('99).

2162 Hamilton beds. On road south of Worcester, up the hill above road to southwest. C. S. Prosser, collector. 1895 ('99).

2163 Ithaca beds? Loose shales on roadside below Cooksburg, Albany co., at base of Oneonta. C. S. Prosser, collector. 1897 ('99).

2164 Chemung beds. On small brook west of main brook and red schoolhouse, north of Harpursville. C. S. Prosser, collector. 1897 ('99).

2165 Ithaca group. Upper part of glen one mile south of Colliersville. C. S. Prosser, collector. 1895 ('99).

RECORD OF FOREIGN LOCALITIES

Specimens bearing lemon yellow tickets

Numbers begin at 100.

100 Fossils from the Spiriferen-sandstein, n. w. Harz mountains, Germany. From Prof. A. von Koenen, Göttingen, Germany. Exchange. 1889.

101 Middle and upper Devonic brachiopods from the Ural mountains. From Th. Tschernyschew, St Petersburg. Donation. 1890.

102 Siluric fossils from Estland and Island of Oesel. From Dr Friedrich Schmidt, St Petersburg. Donation. 1893.

103 Ostracoda from various geologic horizons in England. From Prof. T. Rupert Jones, London. Donation. 1890?

104 Siluric brachiopods; mostly from England. From Agnes Crane, Brighton, England. Donation. 1890.

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REPORT

OF THE

STATE BOTANIST

1899

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REPORT

OF THE

STATE BOTANIST

1899

To the Honorable the Regents of the University of the State of New York

Gentlemen: I have the honor of submitting to you my report of work done in the botanical department of the state museum during the year 1899.

Specimens of plants for the herbarium have been collected in the counties of Albany, Cayuga, Columbia, Lewis, Oswego, Saratoga, St Lawrence, Sullivan, Ulster, Rensselaer, Warren and Wayne. Specimens have been received from correspondents either as contributions or for identification that were collected in the counties of Albany, Erie, Essex, Cattaraugus, Oneida, Onondaga, Ontario, Otsego, Schoharie, St Lawrence and Tioga. The number of species of which specimens have been added to the herbarium is 333. Of these 47 were not before represented in it and the remaining 286 are new varieties or forms, or improved specimens of species already imperfectly represented. The number of species not before reported but now given as additions to our flora is 62. Some of these consist of former varieties now raised to the rank of species. Of the newly reported species 20 are deemed new and are now described as such. All of these are fungi.

A list of the names of the species of which specimens have been added to the herbarium is marked **A.**

A list of the names of the species contributed and of their respective contributors is marked **B.** This list contains the names of 36 contributors of whom 19 have sent specimens collected beyond our state limits.

The 62 species not before reported as belonging to our flora are noticed in a part of the report marked **C.** This includes some

plants formerly considered as mere varieties or forms of species previously reported, some that have been recently introduced into our state and some that are considered and described as new species.

A record of observations on certain previously reported species, with remarks concerning them, and descriptions of newly discovered varieties is marked **D.**

On the east side of Lake Bonaparte in the northern part of Lewis county is an extensive swamp. Its geographic position is such that it seemed to me to be worth while to investigate its flora. A somewhat limited exploration revealed 129 species of flowering plants and ferns growing in it. Remarks concerning these and a list of their names will be found in a part of the report marked **E.**

The season of 1899 has been recognized as one specially unfavorable to the production of fleshy fungi in our state. The rainfall was generally deficient, and such showers as came were for the most part followed by high winds and low temperature, which counteracted the favorable influence that otherwise might have been exerted by them on this crop. Throughout the state the amount of rainfall as reported in July was below the normal quantity. In Ulster county and a limited region contiguous to it, the amount was slightly above the normal. As an indication of the intimate connection between an abundant rainfall and a plentiful crop of fleshy fungi, reports came to me from this region, alone of all the state, that mushrooms were abundant there. Mycologists at Minnewaska and Cragsmoor reaped a rich harvest of them during July and August. Notwithstanding their general scarcity, 18 species have been added to our state flora, and 13 species have been tested and proved to be edible.

One species, Agaricus silvicola, has been added to our list of edible species on the attestation of others whose evidence is considered entirely reliable. Colored figures of these 14 species have been prepared and placed on plates of the same size as those previously published. Plain and simple descriptions of them have been prepared corresponding in plan to those in previous reports. This matter, with the accompanying illustrations, is published apart from this report, as *Museum memoir 4*.

Four plates, illustrating 11 new species and varieties, have been prepared. They are marked A, B, C and D respectively.

There seems to be a tendency among scientists to discard entirely the use of initial capital letters in writing specific names. In order

that the botanical department of the state museum may be in harmony with the other departments in this respect, initial capitals of specific names are not used in this report. This usage has also been extended to generic names when employed in the common designation of a species.

Respectfully submitted

CHARLES H. PECK

State botanist

Albany, 21 *Dec.* 1899

A

PLANTS ADDED TO THE HERBARIUM

New to the herbarium

Viola arenaria *DC.*
Fragaria americana (*Porter*) *Britton*
Aster nobilis *Burgess*
Bidens comosa (*Gray*) *Wiegd.*
B. melanocarpa *Wiegd.*
Azalea canescens *Mx.*
Scrophularia marylandica *L.*
Collomia linearis *Nutt.*
Euphorbia nicaeensis *All.*
Heteranthera dubia (*Jacq.*) *MacM.*
Panicum minus (*Muhl.*) *Nash*
Sporobolus neglectus *Nash*
Hordeum jubatum *L.*
Dicranella subulata *Schimp.*
Cladonia floerkeana *Fr.*
C. bellidifolia (*Ach.*) *Schaer.*
C. digitata (*L.*) *Hoffm.*
C. macilenta (*Ehrh.*) *Hoffm.*
Amanita onusta *Howe*
Clitocybe centralis *Pk.*
C. multiformis *Pk.*
Pleurotus similis *Pk.*
P. cornucopioides *Pers.*
P. candidissimus *B. & C.*
Hygrophorus laricinus *Pk.*
H. subviolaceus *Pk.*
Russula palustris *Pk.*
R. flaviceps *Pk.*
R. granulata *Pk.*
Entoloma graveolens *Pk.*
Hebeloma pascuense *Pk.*
Naucoria pennsylvanica *B. & C*
Psilocybe unicolor *Pk.*
P. dichroa (*Pers.*) *Karst.*
Boletus mutabilis *Morg.*
Boletinus grisellus *Pk.*
Trametes ohiensis *Berk.*
Hydnum populinum *Pk.*
H. combinans *Pk.*
Grandinia burtii *Pk.*
Odontia acerina *Pk.*
Scleroderma verrucosum (*Bull.*) *Pers.*
Diplodia conigena *Desm.*
Gloeosporium melanconioides *Pk*
Monilia sitophila (*Mont.*) *Sacc.*
Acrostalagmus cinnabarinus *Cd.*
Puccinia asparagi *DC.*

Not new to the herbarium

Clematis virginiana *L.*
Aconitum noveboracense *Gray*
Ranunculus abortivus *L.*
R. hispidus *Mx.*
Actaea alba (*L.*) *Mill.*
Menispermum canadense *L.*
Brassica nigra (*L.*) *Koch*
Sisymbrium altissimum *L.*
Raphanus sativus *L.*
Viola renifolia *Gray*
V. primulaefolia *L.*
V. canadensis *L.*
V. communis *Pollard*
Arenaria serpyllifolia *L.*
Dianthus barbatus *L.*
Tissa marina (*L.*) *Britton*
Drosera rotundifolia *L.*
D. intermedia *Hayne*
Linum usitatissimum *L.*
Oxalis violacea *L.*
Rhus glabra *L.*
Ptelea trifoliata *L.*
Acer spicatum *Lam.*
Lespedeza frutescens (*L.*) *Britton*
Crataegus punctata *Jacq.*
C. coccinea *L.*
Aronia nigra (*Willd.*) *Britton*
A. arbutifolia (*L.*) *Ell.*
Prunus virginiana *L.*
Ribes rubrum *L.*
Hamamelis virginiana *L.*
Cephalanthus occidentalis *L.*

Epilobium strictum *Muhl.*
E. lineare *Muhl.*
Parsonsia petiolata (*L.*) *Rusby*
Micrampelis lobata (*Mx.*) *Greene*
Lonicera oblongifolia (*Goldie*) *Hook.*
Viburnum lentago *L.*
V. cassinoides *L.*
Thaspium barbinode (*Mx.*) *Nutt.*
Galium mollugo *L.*
G. trifidum *L.*
Valerianella locusta (*L.*) *Bettke*
Valeriana sylvatica *Banks*
Solidago hispida *Muhl.*
S. nemoralis *Ait.*
S. odora *Ait.*
S. puberula *Nutt.*
S. patula *Muhl.*
S. ulmifolia *Muhl.*
S. macrophylla *Pursh*
Aster macrophyllus *L.*
A. divaricatus *L.*
A. cordifolius *L.*
A. lowrieanus *Porter*
A. lateriflorus (*L.*) *Britton*
A. concinnus *Willd.*
A. paniculatus *Lam.*
A. salicifolius *Lam.*
A. novi-belgii (*T. & G.*) *Gray*
A. acuminatus *Mx.*
Helianthus tuberosus *L.*
Rudbeckia laciniata *L.*
Gnaphalium uliginosum *L.*
Antennaria plantaginifolia (*L.*) *Richards.*
Bidens connata *Muhl.*
B. cernua *L.*
B. laevis (*L.*) *B. S. P.*
Ambrosia artemisiaefolia *L.*
Anthemis arvensis *L.*
Xanthium strumarium *L.*
Carduus discolor (*Muhl.*) *Nutt.*
Hieracium canadense *Mx.*
Nabalus albus (*L.*) *Hook.*
N. trifoliatus *Cass.*
Vaccinium atrococcum (*Gray*) *Heller*
Kalmia glauca *Ait.*
K. angustifolia *L.*
Rhodora canadensis *L.*
Hypopitys hypopitys (*L.*) *Small*
Andromeda polifolia *L.*
Scrophularia leporella *Bicknell*
Pentstemon pentstemon (*L.*) *Britton*
Plantago lanceolata *L.*
Asclepias incarnata *L.*
Gentiana quinquefolia *L.*
G. crinita *Froel.*
Convolvulus japonicus *Thunb.*
Cuscuta gronovii *Willd.*
Solanum dulcamara *L.*
Bartonia virginica (*L.*) *B. S. P.*
Monardia clinopodia *L.*
Euphorbia peplus *L.*
Utricularia cornuta *Mx.*
U. clandestina *Nutt.*
Humulus lupulus *L.*
Lappula lappula (*L.*) *Karst.*
Mertensia virginica (*L.*) *DC.*
Polygonum careyi *Olney*
P. lapathifolium *L.*
P. convolvulus *L.*
P. cilinode *Mx.*
P. sagittatum *L.*
Chenopodium glaucum *L.*
C. hybridum *L.*
Atriplex hastata *L.*
Fraxinus americana *L.*
F. pennsylvanica *Marsh.*
Populus tremuloides *Mx.*
Salix candida *Fluegge*
Betula pumila *L.*
Corylus rostrata *Ait.*
Picea mariana (*Mill.*) *B. S. P.*
Larix laricina (*Du Roi*) *Koch*
Corema conradi *Torr.*
Sparganium simplex *Huds.*
Alisma plantago-aquatica *L.*
Habenaria blephariglottis (*Willd.*) *Torr.*
Peramium pubescens (*Willd.*) *MacM.*
Limodorum tuberosum *L.*
Cypripedium reginae *Walt.*
Lilium canadense *L.*
Polygonatum commutatum (*R. & S.*) *Dietr.*
Uvularia grandiflora *Sm.*
Vagnera trifolia (*L.*) *Morong*

Vagnera stellata (*L.*) *Morong*
Unifolium canadense (*Desf.*) *Greene*
Juncus articulatus *L.*
J. balticus *Willd.*
Cyperus diandrus *Torr.*
Eleocharis ovata (*Roth*) *R. & S.*
E. tenuis *Schultes*
E. acuminata (*Muhl.*) *Nees*
Scirpus atrovirens *Muhl.*
S. microcarpus *Presl.*
S. lacustris *L.*
Stenophyllus capillaris (*L.*) *Britton*
Eriophorum virginicum *L.*
Carex folliculata *L.*
C. limosa *L.*
C. pauciflora *Lightf.*
C. vulpinoidea *Mx.*
C. tribuloides *Wahl.*
C. scoparia *Schk.*
Panicum capillare *L.*
P. proliferum *Lam.*
P. dichotomum *L.*
P. lanuginosum *Ell.*
P. boreale *Nash*
Agrostis perennans (*Walt.*) *Tuckm.*
Muhlenbergia diffusa *Schreb.*
Sporobolus serotinus (*Torr.*) *Gray*
S. longifolius (*Torr.*) *Wood*
S. vaginaeflorus (*Torr.*) *Wood*
Festuca elatior *L.*
F. duriuscula *L.*
Oryzopsis melanocarpa *Muhl.*
Aristida dichotoma *Mx.*
Spartina cynosuroides (*L.*) *Willd.*
Eatonia nitida (*Spreng.*) *Nash*
Sieglingia seslerioides (*Mx.*) *Scribn.*
Phragmites phragmites (*L.*) *Karst.*
Poa alsodes *Gray*
Eragrostis eragrostis (*L.*) *Karst.*
E. capillaris (*L.*) *Nees*
Elymus virginicus *L.*
E. striatus *Willd.*
Agropyron repens (*L.*) *Bv.*
Hystrix hystrix (*L.*) *Millsp.*
Bromus racemosus *L.*
Onoclea sensibilis *L.*
Dryopteris cristata (*L.*) *Gray*
D. marginalis (*L.*) *Gray*
Asplenium montanum *Willd.*
A. filix-foemina (*L.*) *Bernh.*
A. platyneuron (*L.*) *Oakes*
Woodwardia virginica (*L.*) *Sm.*
Lycopodium inundatum *L.*
Isoetes engelmanni *A. Br.*
Sphagnum pylaesii *Brid.*
S. rigidum *Schimp.*
S. cuspidatum *Ehrh.*
S. recurvum *Bv.*
S. cymbifolium *Ehrh.*
S. medium *Limpr.*
S. squarrosum *Pers.*
S. wulfianum *Girgen.*
Rhabdoweisia fugax *B. & S.*
Dicranum flagellare *Hedw.*
D. fuscescens *Turn.*
D. longifolium *Hedw.*
D. scoparium *Hedw.*
D. montanum *Hedw.*
D. starkii *W. & M.*
Oncophorus Wahlenbergii *Brid.*
Fissidens osmundoides *Hedw.*
Leptotrichum vaginans *L. & J.*
Grimmia apocarpa *Hedw.*
Racomitrium aciculare *Brid.*
R. sudeticum *B. & S.*
R. fasciculare *Brid.*
R. microcarpum *Brid.*
Hedwigia ciliata *Ehrh.*
Ulota crispa *Brid.*
U. crispula *Brid.*
Orthotrichum anomalum *Hedw.*
Webera elongata *Schwaegr.*
Bryum pseudotriquetrum *Schwaegr.*
Mnium spinulosum *B. & S.*
M. drummondii *B. & S.*
Aulacomnion palustre *Schwaegr.*
Pogonatum urnigerum *Bv.*
P. tenue (*Menz.*) *E. G. Britton*
Polytrichum strictum *Banks*
P. commune *L.*
P. juniperinum *Willd.*
Buxbaumia aphylla *L.*
Fontinalis dalecarlica *B. & S.*
Homalia jamesii *Schimp.*
Hypnum blandovii *W. & M.*
H. pulchellum *Dicks.*

Hypnum denticulatum *L.*
H. muhlenbeckii *Spruce*
H. subtile *Hoffm.*
H. serpens *L.*
H. rugosum *L.*
H. montanum *Wils.*
H. stramineum *Dicks.*
H. abietinum *L.*
Jungermannia inflata *Huds.*
Umbilicaria dillenii *Tuckm.*
U. proboscidea *L.*
U. muhlenbergii (*Ach.*) *Tuckm.*
U. pennsylvanica *Hoffm.*
Peltigera canina (*L.*) *Hoffm.*
Parmelia crinita *Ach.*
P. physodes (*L.*) *Ach.*
P. pertusa (*Schrank*) *Schaer.*
Physcia tribacia (*Ach.*) *Tuckm.*
Baeomyces roseus *Pers.*
Cladonia pyxidata (*L.*) *Fr.*
C. fimbriata (*L.*) *Fr.*
C. symphycarpa *Fr.*
C. mitrula *Tuckm.*
C. papillaria (*Ehrh.*) *Hoffm.*
C. cariosa (*Ach.*) *Spreng.*
C. gracilis *Fr.*
C. squamosa *Hoffm.*
C. furcata (*Huds.*) *Fr.*
C. rangiferina (*L.*) *Hoffm.*
C. amaurocrea (*Fl.*) *Schaer.*
C. uncialis (*L.*) *Fr.*
C. deformis *Hoffm.*
Cladonia cristatella *Tuckm.*
Amanitopsis volvata (*Pk.*) *Sacc.*
Armillaria mellea *Vahl.*
Mycena subincarnata *Pk.*
Hygrophorus miniatus *Fr.*
Pleurotus serotinus *Schrad.*
P. ulmarius (*Bull.*) *Sow.*
Lentinus cochleatus *Fr.*
Entoloma strictius *Pk.*
Galera hypnorum (*Batsch*) *Fr.*
Cortinarius armillatus (*A. & S.*) *Fr.*
C. sphagnophilus *Pk.*
Paxillus involutus (*Batsch*) *Fr.*
Psilocybe elongatipes *Pk.*
Boletus spectabilis *Pk.*
B. elbensis *Pk.*
B. clintonianus *Pk.*
Hydnum chrysocomum *Underw.*
Irpex tulipiferae *Schw.*
Clavaria pistillaris *L.*
Calostoma cinnabarinum *Desv.*
Lycogala miniatum *Pers.*
Puccinia phragmitis (*Schum.*) *Korn.*
P. graminis *Pers.*
P. convolvuli (*Pers.*) *Cast.*
P. hieracii (*Schum.*) *Mart.*
P. xanthii *Schw.*
Uromyces euphorbiae *C. & P.*
Ustilago utriculosa (*Nees*) *Tul.*
Uncinula clintonii *Pk.*
Erysiphe communis (*Wallr.*) *Fr.*
Microsphaera menispermi *Howe*

B

CONTRIBUTORS AND THEIR CONTRIBUTIONS

Mrs E. C. Anthony, Gouverneur N. Y.

Viola primulaefolia *L.*
V. renifolia *Gray*
Panus strigosus *B. & C.*
Cortinarius rimosus *Pk.*

Miss H. C. Anderson, Lambertville N. J.

Geaster limbatus *Fr.*
G. minimus *Schw.*
G. hygrometricus *Pers.*
Calostoma lutescens (*Schw.*) *Burn.*
C. cinnabarinum *Desv.*
C. ravenelii (*Berk.*) *Mass.*

Mrs Thomas B. Bishop, San Francisco Cal.

Sarcodes sanguinea *Torr.*
Sequoia gigantea *Dec.*
S. sempervirens *Endl.*

Mrs E. B. Blackford, Boston Mass.

Amanita crenulata *Pk.*
Polyporus lucidus (*Leys.*) *Fr.*
Cordyceps capitata (*Holmsk.*) *Lk.*

Mrs G. W. Conklin, Brooklyn N. Y.

Agaricus hemorrhoidarius *Kalchb.*

Miss L. Detwiller, Jersey City N. J.

Ramalina reticulata (*Noehd.*) *Krempelh.*
Evernia vulpina (*L.*) *Ach.*

Miss H. M. Noyes, Auburndale Mass.

Agaricus brunnescens *Pk.*

Miss M. L. Overacker, Syracuse N. Y.

Onosmodium carolinianum (*Lam.*) *DC.*

Mrs L. A. Millington, New Russia N. Y.

Gentiana crinita *Froel.*
Botrychium matricariaefolium *Braun*
Ophioglossum vulgatum *L.*

Mrs L. L. Goodrich, Syracuse N. Y.

Chenopodium anthelminticum *L.*

Miss M. E. Whetstone, Minneapolis Minn.

Boletus luteus *L.*

Mrs E. M. Williams, Takoma Park D. C.

Lepiota rugulosa *Pk.*
Hypholoma irregulare *Pk.*

Mrs A. M. Hadley, Manchester N. H.

Amanitopsis strangulata (*Fr.*) *Roze*
Sparassis herbstii *Pk.*
Boletus edulis clavipes *Pk.*
Polyporus albiceps *Pk.*

E. D. Merrill, Orono Me.

Weisia viridula *Brid.*
Dicranella cerviculata *Schp.*
Dicranum spurium *Hedw.*
D. longifolium *Ehrh.*
Leptotrichum vaginans *L. & J.*
Encalypta ciliata *Hedw.*
Mnium venustum *Mitt.*
Grimmia apocarpa *Hedw.*
Racomitrium sudeticum *B. & S.*
Racomitrium lanuginosum *Brid.*
Diphyscium foliosum *Mohr.*
Bartramia pomiformis *Hedw.*
Pogonatum alpinum *Roehl.*
Polytrichum ohiense *R. & C.*
Dichelyma pallescens *B. & S.*
Anomodon attenuatus *Hueben.*
Leskea polycarpa *Ehrh.*
Alsia abietina *Sulliv.*

Antitrichia curtipendula *Brid.*
Neckera menziesii *Drummond*
Climacium americanum *Brid.*
Thuidium scitum (*Bv.*) *Aust.*
Hypnum populeum *Hedw.*
H. novae-angliae *S. & L.*
H. campestre *Bruch*
H. ochraceum *Turn.*
H. rusciforme *Weis*
H. oreganum *Sulliv.*
H. muhlenbeckii *Spruce*
Hypnum denticulatum *L.*
Jungermannia setiformis *Ehrh.*
Scapania nemorosa *Dumort*
S. undulata *Dumort*
Plagiochila asplenoides *Dumort*
Trichocolea tomentella *Dumort*
Porella navicularis *Lindb.*
Endocarpon miniatum (*L.*) *Ach.*
Umbilicaria vellea (*L.*) *Nyl.*
Sphaerophoron fragilis (*L.*) *Ach.*
Thamnolia vermicularis (*Sw.*) *Schaer.*

J. M. Clarke, Albany N. Y.

Taraxacum taraxacum (*L.*) *Karst.* Monstrosity of blossom
Pleurotus ulmarius *Bull.*

David F. Day, Buffalo N. Y.

Gymnosporangium clavipes *C. & P.*

C. L. Fox, Portland Me.

Cordyceps nigriceps *Pk.*

G. E. Morris, Waltham Mass.

Amanita crenulata *Pk.*
Cordyceps capitata (*Holmsk.*) *Lk.*

C. G. Lloyd, Cincinnati O.

Coprinus angulatus *Pk.*
Echinodontium tinctorium *E. & E.*

L. H. Peet, Brooklyn N. Y.

Diplodia conigena *Desm.*

W. Paddock, Geneva N. Y.

Gloeosporium melanconioides *Pk.*
Macrophoma curvispora *Pk.*

F. C. Stewart, Geneva N. Y.

Acrostalagmus cinnabarinus *Cd.*

W. G. Tucker, Albany N. Y.

Monilia sitophila (*Mont.*) *Sacc.*

J. Peter, Detroit Mich.

Festuca elatior *L.*
Bromus racemosus *L.*
Agropyron repens (*L.*) *Bv.*
Hystrix hystrix (*L.*) *Millsp.*
Roripa hispida (*Desv.*) *Britton*
Thaspium barbinode (*Mx.*) *Nutt.*
Ptelea trifoliata *L.*
Valerianella locusta (*L.*) *Bettke*
Arenaria serpyllifolia *L.*
Lappula lappula (*L.*) *Karst.*
Polygonum convolvulus *L.*
Juncus balticus *Willd.*

Juncus articulatus *L.*
J. canadensis *Gay*
Scirpus atrovirens *Muhl.*
Scirpus lacustris *L.*
S. microcarpus *Presl.*
Eleocharis acuminata (*Muhl.*) *Nees*

C. S. Banks, Albany N, Y.

Puccinia asparagi *DC.*

G. W. Baker, Oswego Center N. Y.

Proliferous tuber of Solanum tuberosum *L.*

E. A. Bartlett, Albany N. Y.

Taraxacum taraxacum (*L.*) *Karst.* Monstrosity of blossom

H. C. Beardslee, Cleveland O.

Arcyria nutans *Rost.*
A. oerstedii *Rost.*
Chondrioderma spumarioides *Fr.*
Comatricha pulchella *Bab.*
C. ellisii *Morg.*
Craterium leucocephalum *Ditm.*
C. minimum *B. & C.*
Clastoderma debaryanum *Blytt.*
Cribraria violacea *Rex*
C. cuprea *Morg.*
Didymium farinaceum *Schrad.*
Enerthenema papillatum *Pers.*
Hemiarcyria oblata *Morg.*
Physarum diderma *Rost.*
P. pulcherrimum *B. & Br.*
P. berkleyi *Rost.*
P. connexum *Lk.*
P. contextum *Pers.*
P. leucophaeum *Fr.*
P. gravidum *Morg.*

E. B. Conger, Peninsula O.

Hydrastis canadensis *L.*

C. M. Crouse, Syracuse N. Y.

Plantago major *L.*

M. Craig, Corvallis Or.

Aecidium grossulariae *DC.*
Ae. ranunculi *Schw.*
Uromyces polygoni (*Pers.*) *Fckl.*
Puccinia giliae *Hark.*
P. menthae *Pers.*
Puccinia asarina *Kunze*
P. mertensiae *Pk.*
P. circaeae *Pers.*
P. melanconioides *E. & H.*
P. porphyrogenita *Curt.*

E. B. Sterling, Trenton N. J.

Cyclomyces greenii *Berk.*
Lepiota procera *Scop.*

C. McIlvaine, Colebrook Pa.

Secotium warnei *Pk.*
Fistulina hep. monstrosa *Pk.*

E. Bethel, Denver Col.

Lentinus lepideus *Fr.*
Coprinus comatus *Fr.*
Mitrula cucullata *Fr.*

Rev. R. L. Welch, Oneonta N. Y.

Euphorbia peplus *L.*

L. H. Pammel, Ames Ia.

Hepatica acutiloba *Ait.*
Anemone cylindrica *Gray*
Ranunculus abortivus *L.*
R. septentrionalis *Poir.*
Isopyrum biternatum *T. & G.*
Aquilegia canadensis *L.*
Dicentra cucullaria *DC.*
Arabis dentata *T. & G.*
Nasturtium palustre *DC.*
Thelypodium pinnatifidum *Wats.*
Brassica sinapistrum *Boiss.*
Viola pedatifida *G. Don.*
V. scabriuscula *Schw.*
Silene nivea *Otth.*
Linum sulcatum *Riddell*
Amorpha canescens *Nutt.*
A. fruticosa *L.*
Mollugo verticillata *L.*
Antennaria plantaginifolia *Hook.*
Anthemis cotula *DC.*
Phlox divaricata *L.*
Cynoglossum officinale *L.*
Physalis lanceolata *Mx.*
Veronica anagallis *L.*
Teucrium canadense *L.*
Blephilia hirsuta *Benth.*
Rumex crispus *L.*
Polygonum muhlenbergii *Wats.*
Smilacina stellata *Desf.*
Cyperus strigosus *L.*
C. erythrorhizos *Muhl.*
C. dian. castaneus *Torr.*
Scirpus lacustris *L.*
Eriophorum lineatum *B. & H.*
Carex asa-grayi *Bailey*
C. stricta *Lam.*
C. lax. blanda (*Dew.*) *Boott*
C. vulpinoidea *Mx.*
C. rosea *Schk.*
Panicum glabrum *Gaud.*
P. sanguinale *L.*
P. proliferum *Lam.*
P. virgatum *L.*
Setaria viridis *Bv.*
S. verticillata *Bv.*
Leersia oryzoides *Swartz*
Andropogon furcatus *Muhl.*
Chrysopogon nutans *Benth.*
Phalaris arundinacea *L.*
Melica diffusa *Pursh*
Hierochloe borealis *R. & S.*
Muhlenbergia glomerata *Trin.*
M. mexicana *Trin.*
Sporobolus cuspidatus *Torr.*
S. vaginaeflorus *Vasey*
Agrostis alba *L.*
Cinna arundinacea *L.*
Eatonia pennsylvanica *Gray*
Eragrostis reptans *Nees*
E. pectinacea *Gray*
Poa serotina *Ehrh.*
P. alsodes *Gray*
Glyceria nervata *Trin.*
G. fluitans *R. Br.*
Festuca rubra *L.*
F. elatior *L.*
F. shortii *Kunth*
Agropyron caninum *R. & S.*
A. tenerum *Vasey*
Equisetum arvense *L.*
Ustilago avenae (*P.*) *Jens.*
U. hypodites (*Schl.*) *Fr.*
U. hordei (*Pers.*)
U. maydis (*DC.*) *Cd.*
U. neglecta *Niessl*
U. nuda (*Jens.*) *Kell.*
U. rabenhorstiana *Kuhn*
U. segetum (*Bull.*) *Dittm.*
U. syntherismae *Schw.*
U. tritici (*Pers.*) *Jens.*
U. utriculosa (*Nees*) *Tul.*
Urocystis agropyri (*Preuss*) *Schroet.*
Tilletia striiformis (*West.*) *Mag.*
Uromyces acuminatus *Arth.*
U. appendiculatus (*Pers.*) *Lk.*
U. caladii (*Schw.*) *Farl.*

Uromyces caryophyllina (*Schrank*)
U. polygoni (*Pers.*) *Fckl.*
Phragmidium subcorticium (*Schrank*)
Coleosporium solidaginis (*Schw.*)
Puccinia caricis (*Schum.*) *Reb.*
P. anemones-virginianae *Schw.*
P. coronata *Cd.*
P. graminis *Pers.*
P. hieracii (*Schum.*) *Mart.*
P. obtecta *Pk.*
P. polygoni *Pers.*
Puccinia rubigo-vera (*DC.*) *Wint.*
P. silphii *Schw.*
P. sorghi *Schw.*
P. stipae *Arth.*
P. thalictri *Chev.*
Aecidium euphorbiae *Gmel.*
Ae. porosum *Pk.*
Rhytisma acerinum (*Pers.*) *Fr.*
R. salicinum (*Pers.*) *Fr.*
Plasmopara viticola (*B. & C.*) *B. & D.*
Schizonella melanogramma (*DC.*)

F. E. Fenno, Apalachin N. Y.

Adlumia fungosa (*Ait.*) *Greene*
Helianthemum canadense (*L.*) *Mx.*
Collomia linearis *Nutt.*
Vicia americana *Muhl.*
Comarum palustre *L.*
Linum virginianum *L.*
Epilobium lineare *Muhl.*
Mollugo verticillata *L.*
Viburnum lentago *L.*
Eupatorium purpureum *L.*
Aster laevis *L.*
Rudbeckia hirta *L.*
Anthemis arvensis *L.*
Cacalia suaveolens *L.*
Lobelia spicata *Lam.*
Azalea canescens *Mx.*
Leptandra virginica (*L.*) *Nutt.*
Mertensia virginica (*L.*) *DC.*
Lithospermum officinale *L.*
Scrophularia leporella *Bicknell*
Asclepias tuberosa *L.*
Pentstemon pentstemon (*L.*) *Britton*
Agastache scrophulariaefolia (*Willd.*) *Kuntze*
Trichostema dichotomum *L.*
Monarda clinopodia *L.*
Phlox subulata *L.*
Euphorbia nicaeensis *All.*
Rumex altissimus *Wood*
Atriplex patula *L.*
Heteranthera dubia (*Jacq.*) *MacM.*
Scirpus lacustris *L.*
S. torreyi *Olney*
Fimbristylis capillaris *Gray*
Carex lupulina *Muhl.*
Panicum proliferum *Lam.*
Muhlenbergia tenuiflora (*Willd.*) *B. S. P.*
Eragrostis capillaris (*L.*) *Nees*
E. pectinacea (*Mx.*) *Steud.*
Bromus kalmii *Gray*
B. racemosus *L.*
Poa trivialis *L.*
P. debilis *Torr.*
Panicularia borealis *Nash*
P. acutiflora (*Torr.*) *Kuntze*
Festuca duriuscula *Lam.*
Avena striata *Mx.*
Danthonia compressa *Aust.*
Sporobolus vaginaeflorus (*Lam.*) *Wood*
Eatonia nitida (*Spreng.*) *Nash*
Cinna arundinacea *L.*
C. latifolia (*Trev.*) *Griseb.*
Lolium italicum *A. Br.*
Hordeum jubatum *L.*
Elymus striatus *Willd.*
Lycopodium annotinum *L.*
Isoetes engelmanni *A. Br.*

P. L. Ricker, Orono Me.

Hydnum auriscalpium *Fr.*
Sphaerella pachyasca *Rost.*
Cenangium abietis (*Pers.*) *Rehm*
Phoma landeghemiae (*Nits.*) *Sacc.*

C

SPECIES NOT BEFORE REPORTED

Edible fungi are reported in Museum memoir 4, *Report of the state botanist on edible fungi* 1895-99

Anemone riparia *Fernald*

Rocky places. Sullivan and Washington counties. July. This plant has been regarded as a variety of Anemone virginiana L. and was reported as Anemone virginiana alba Wood. Mr Fernald, after a careful study of many specimens, has reached the conclusion that it is a good species and has described it under the name here given. Its white flowers and its fruit heads furnish distinguishing characters. The latter are intermediate in size between those of A. virginiana L. and A. cylindrica Gray.

Viola arenaria *DC.*

Light sandy soil. North Elba. June. The species is closely allied to V. labradorica Schrank, from which it may be separated by its minute puberulence and by its comparatively longer and more tapering flower spur.

Potentilla pumila *Poir.*

Poor soil in pastures and by roadsides. Albany county. May.

Fragaria americana (*Porter*) *Britton*

Thin woods. Harrisville, Lewis co. Fruit ripe in July.

Aster nobilis *Burgess*

Rocky places by roadside. Sandlake, Rensselaer co. August. A fine, large species with very large basal leaves. It is allied to A. macrophyllus.

Aster concinnus *Willd.*

Hillsides near Whitehall. September. Closely related to A. laevis L., from which it may be separated by its more narrow, lanceolate or linear leaves. The lower ones are sometimes greatly elongated and occasionally have a few large, spreading teeth on their margin.

Bidens melanocarpa *Wiegd.*

Shore of Kinderhook lake, Columbia co. September. This species resembles B. frondosa L., from which it is separated by its smaller heads, orange colored flowers, fewer involucral bracts and more narrow achenes.

Bidens comosa (*Gray*) *Wiegd.*

With the preceding along the shore of Kinderhook lake, but more abundant. It was formerly thought to be a variety of B. connata Muhl. A dwarf form occurs which is only a few inches high. Its leaves are small and blunt.

Vaccinium nigrum (*Wood*) *Britton*

Poor soil in sandy and also in rocky places. Caroga, Fulton co. and Conklingville, Saratoga co. The species is separated from V. pennsylvanicum Lam., of which it was formerly considered a variety, by its black fruit, which sometimes grows very large.

Azalea canescens *Mx.*

Swamps and their borders. Apalachin, Tioga co. and Machias, Cattaraugus co. F. E. Fenno.

Lysimachia producta (*Gray*) *Fernald*

Low wet ground. Glens Falls and Watertown. C. L. Williams. Narrowsburg, Sullivan co. July. This was reported as a variety of L. stricta, but specific distinction has recently been given it.

Lysimachia polyantha *Fernald*

Low wet ground near Narrowsburg, where it was found growing with the preceding species. Also near Elizabethtown, Essex co. These species and L. terrestris (L.) B. S. P. sometimes grow together in such a way as to lead to the conclusion that all are forms of one species.

Scrophularia leporella *Bicknell*

River banks. Apalachin and Machias. It is the common species in these localities. F. E. Fenno. S. marylandica L. occurs near Rosendale

Collomia linearis *Nutt.*

Along the railroad at Lime Lake, Cattaraugus co., where it is plentiful, but doubtless introduced from the west. July. F. E. Fenno.

Euphorbia nicaeensis *All.*

Various places along the Susquehanna river in Tioga county, and abundant about Barton. Introduced but well established and considered a vile weed. May. F. E. Fenno. The name here used is applied to this plant in the *Manual* and in *Illustrated flora*, but in Norton's revision of the American species of the section Tithymalus of the genus Euphorbia, Euphorbia lucida Waldst. & Kit. is taken to be its proper designation.

Convolvulus japonicus *Thunb.*

Roadsides and waste places about dwellings. Elizabethtown and Claryville. July and August. This is an introduced plant, a double flowered form of which is cultivated for ornament and sometimes escapes from cultivation.

Heteranthera dubia (*Jacq.*) *MacM.*

Muddy shore of Allegheny river near Olean. August. A small form of which only one specimen was found in flower. F. E. Fenno.

Cyperus rivularis *Kunth*

Near Patchogue. August. This species closely resembles C. diandrus Torr., from which it may be distinguished by its shorter styles, more narrow and shining spikelets and more slender habit.

Panicum walteri *Pursh*

Ditches and wet places. Cayuga marshes. W. R. Dudley. Not rare. Formerly considered a variety of P. crus-galli L. and reported under the name P. crus-galli hispidum Torr.

Panicum linearifolium *Scribn.*

Dry soil. Little Stissing mountain, Dutchess co. July. This grass closely resembles P. depauperatum Muhl., from which it is separated by its pubescent spikelets and small secondary panicles near the base of the stem.

Panicum minus (*Muhl.*) *Nash*

Dry hilly woods and pastures. Rosendale. September.

Sporobolus neglectus *Nash*

Dry soil. Whitehall, Sandlake and Catskill mountains. September. This species differs from its near relative, S. vaginaeflorus, by its shorter spikelets.

Hordeum jubatum *L.*

Along the railroad and in yards. Apalachin. July. F. E. Fenno. Watkins. D. Beach. Introduced from the west.

Lycopodium chamaecyparissus *A. Br.*

Light sandy or gravely soil, specially under or near evergreens. North Elba. August. This club moss has generally been classed as a mere form or variety of L. complanatum L., but it is doubtless worthy of specific distinction as indicated in *Torrey Bulletin* 26: 559-67.

Dicranum sauteri *B. & S.*

Dead branches of spruce and balsam fir. North Elba. Mrs E. G. Britton.

Physcia tribacia (*Ach.*) *Tuckm.*

Bark of trees. Montezuma, Cayuga co. October. Not rare but frequently sterile even when forming extensive patches. It has been reported as a variety of P. stellaris.

Cladonia floerkeana *Fr.*

Thin soil on rocks or in their crevices. Fulton Chain. July.

Cladonia bellidiflora (*Ach.*) *Schaer.*

Thin soil on rocks or in their crevices. Jayville, St Lawrence co. July. Our specimens belong to the rock lichen form, which Prof. Tuckerman mentions as approaching closely to C. cornucopioides. The podetia vary much in size and shape.

Cladonia digitata (*L.*) *Hoffm.*

Much decayed wood. Denning, Ulster co. August. Our specimens are remarkable for the large squamules of the thallus and the

very minute apothecia which are scarcely perceptible except on close inspection. By reason of this character they are referable to variety brachytes Ach. This and the two preceding species are rare in our state.

Amanita onusta *Howe*

Sandy and gravelly soil. Claryville, Sullivan co. August. Our specimens are smaller than the typical form and do not rigidly agree in all other respects with the description of the species, but the essential characters correspond so well that we have no doubt that the specimens belong to this species. The discrepancies are easily explained by the variability of the species. The original description was evidently derived from large and mature specimens in which the annulus had disappeared. In our specimens there is present in young plants a very white, flocculent or webby and mealy veil, which ruptures by the expansion of the pileus and adheres partly to the even margin of the pileus and partly to the top of the stem, on which it forms a slight and sometimes fragmentary annulus, which often disappears entirely with age. Its presence indicates that the plant belongs to the genus Amanita and not to Amanitopsis, in which some writers have placed it.

In our specimens the pileus is 1.5 to 2.5 inches broad, and is at first grayish brown or mouse color, thickly set with small, dark brown or blackish warts, but these sometimes disappear to some extent with age and the pileus itself often fades or becomes whitish and slightly striate on the margin. The lamellae are white, close and slightly attached to the stem. The stem is 2 to 3 inches long, 3 to 5 lines thick, solid or slightly spongy in the center, colored like the pileus or paler and commonly slightly thickened at the base but not truly bulbous. It has a root-like prolongation, which penetrates the ground to a depth about equal to the length of the exposed part. The surface is mealy or flocculent above and squamulose below, or in some cases wholly flocculent mealy. The spores are .00035 to .0005 of an inch long, .00024 broad. The species is apparently allied to A. solitaria, but it has no campanulate margined bulb at the base of the stem. It is also near A. polypyramis, but that is described as having a pure white, shining, areolate pileus with thick, pyramidal, central warts.

Amanita calyptrata *Pk.*

PLATE A, *fig. 1–5*

Sandy soil. Gansevoort, Saratoga co. July. Our specimens differ from the typical form of the species in being wholly white or whitish. The type, which was sent from Oregon, has the pileus yellow or yellowish brown, and the lamellae yellowish white, both having a slight tinge of green. The peculiar thick, felty, white fragment of the volva that adheres to and covers the central part of the pileus forms a characteristic feature of the species and is suggestive of its name. This, together with the thick remains of it at the base of the stem, and the more strongly striate margin of the pileus, easily distinguishes the species from A. spreta, to which it is closely allied. Because of its different color I have considered our plant a variety of the species and named it variety albescens. The Oregon plant is known to be edible, but, as only two specimens of the variety were found, no opportunity for testing its edible quality was given.

Amanita multisquamosa *n. sp.*

PLATE B, *fig. 1–7*

Pileus convex, becoming nearly plane, even or but slightly striate on the margin, adorned with numerous angular, erect, persistent but separable warts, white or white with a brown or brownish center, flesh white; lamellae close, free, white; stem equal, glabrous, stuffed with a webby pith or hollow, bulbous at the base, white, annulus white, persistent, the bulb more or less margined above by the remains of the volva; spores subglobose or broadly elliptic, .0003 to .0004 of an inch long, .00024 to .0003 broad.

Pileus 2 to 4 inches broad; stem 1.5 to 4 inches long, 3 to 6 lines thick. Woods and groves. Albany, Rensselaer and Suffolk counties. July.

The species has the volva definitely circumscissile, and after its rupture the free margin sometimes closely sheathes the base of the stem. In some of the specimens the central part of the pileus is areolate rimose, a wart occupying the center of each areola. The warts are more closely placed in the center than toward the margin. From pale forms of A. muscaria this species may be separated by its more crowded, angular, erect warts and by the absence of scales or fragments of the volva from the base of the stem.

Clitocybe centralis *n. sp.*

PLATE C, *fig. 16–20*

Pileus thin, broadly convex or nearly plane, slightly umbilicate, glabrous, hygrophanous, pale grayish brown and faintly striatulate on the thin margin, with the center brown or brownish when moist, grayish white when dry, flesh whitish, taste and odor farinaceous; lamellae thin, close, adnate or slightly decurrent, whitish; stem short, equal, stuffed or hollow, fibrous, colored like the pileus; spores minute, elliptic, .00024 of an inch long, .00012 broad.

Pileus 6 to 15 lines broad; stem 1 to 1.5 of an inch long, 1 to 2 lines thick. Gregarious. In woods among fallen leaves. Essex and Warren counties. September and October.

The brown or brownish umbilicus of the pileus affords a convenient mark by which to recognize the species and it is suggestive of the specific name. In dried specimens this brown color is apt to fade and disappear. The species might easily be taken to belong to the genus Omphalia, but is placed in Clitocybe because of its fibrous stem and slightly decurrent lamellae.

Pleurotus cornucopioides *Pers.*

Decaying wood. Montezuma. October. The characteristic feature of this species is found in the decurrent lamellae. They are prolonged in thin ridges or lines which run down the stem a half-inch or more and give a fluted or striated appearance to its upper part. The stem is eccentric or sometimes nearly central.

Pleurotus similis *n. sp.*

Pileus fleshy, flexible, spathulate, flabellate or suborbicular, convex, glabrous, white or yellowish white, flesh white; lamellae thin, subdistant, decurrent, distinct at the base, white; stem short, ascending, glabrous except at the villose base, solid, very eccentric or lateral, white; spores subelliptic, .0002 to .0003 of an inch long, .00012 to .00016 broad.

Pileus 1 to 2 inches long, nearly as broad; stem 3 to 6 lines long, 2 to 3 thick. Single or cespitose. Prostrate trunks of ironwood, Ostrya virginiana. West Shokan. August.

The resemblance of this species to P. pantoleucus is so close as to suggest the specific name given to it. It differs in its

smaller size, more clustered mode of growth, more distant lamellae, villose tomentose base of the stem and smaller spores. The stem is almost lateral but the pileus usually has a perceptibly entire margin, of which the part nearest the stem is reduced to a narrow thin rim, which is scarcely more than an elevated line in the dried specimens.

Pleurotus candidissimus *B. & C.*

Dead and decaying wood. Warrensburg, Warren co. October.

Hygrophorus subviolaceus *n. sp.*

PLATE C, *fig. 11–15*

Pileus firm, hemispheric becoming convex, glabrous, viscid, hygrophanous, violaceous when moist, paler or grayish when dry, flesh white; lamellae arcuate, distant, decurrent, pale violaceous; stem equal or tapering downward, solid, glabrous, white; spores subglobose or broadly elliptic, .00024 to .0003 of an inch long, .0002 to .00024 broad.

Pileus 1 to 1.5 of an inch broad; stem 1 to 1.5 of an inch long, 2 to 4 lines thick. Damp, mucky ground in swamps. Meadowdale. October.

The species belongs to the tribe Limacium. In the dried specimens the pileus is nearly black and the lamellae are smoky brown.

Russula palustris *n. sp.*

Pileus thin, fragile, subglobose or hemispheric, then convex or nearly plane, viscid when moist, the thin pellicle separable, varying in color from reddish buff to pale purplish red, obscurely tuberculate striate on the margin, flesh white, tinged with reddish buff under the pellicle, taste tardily acrid; lamellae entire, moderately close, whitish becoming yellowish, interspaces venose; stem equal, glabrous, spongy within or hollow, fragile, white, sometimes tinged with red; spores subglobose, .0003 to .0004 of an inch broad, uninucleate.

Pileus 2 to 3 inches broad; stem 1.5 to 3 inches long, 4 to 6 lines thick. Swamps under alders. Jayville, St Lawrence co. August.

Allied to R. decolorans, but smaller, thinner, more fragile, tardily acrid and not discoloring or assuming cinereous hues with age.

Russula flaviceps *n. sp.*

PLATE C, *fig. 6–10*

Pileus convex or centrally depressed, glabrous, viscid, even on the margin when young, slightly tuberculose striate when old, the thin pellicle separable, pale yellow, flesh white, taste mild or slightly acrid; lamellae close, narrow, adnate, slightly rounded behind, pale yellow becoming more yellow and dusted with spores; stem equal or nearly so, stuffed or spongy within, white; spores yellow, subglobose, .0003 of an inch broad.

Pileus 2 to 4 inches broad; stem 1.5 to 2.5 inches long, 4 to 8 lines thick. Woods. Claryville. August.

This species belongs to the tribe Fragiles. From R. ochroleuca it may be separated by its yellow lamellae and spores.

Russula aeruginascens *n. sp.*

Pileus convex, becoming umbilicate or centrally depressed, glabrous, viscid when moist, even on the margin, greenish or yellowish green, flesh white, taste tardily acrid; lamellae narrow, close, many of them once or twice forked, adnate or slightly decurrent, white; stem equal, spongy within, white; spores white, subglobose, .0003 of an inch broad.

Pileus 2 to 3 inches broad; stem 1 to 2 inches long, 6 to 10 lines thick. Woods. Claryville. August.

This species closely resembles R. aeruginea, from which it is separated by its acrid taste, its even margin and its close forked lamellae.

Russula granulata *n. sp.*

PLATE C, *fig. 1–5*

Pileus convex, becoming nearly plane or centrally depressed, viscid when moist, rough with minute granules or squamules, finely tuberculate striate on the margin, dingy yellow tinged with red or brown, flesh white or whitish, taste acrid; lamellae thin, close, adnate, many of them forked at the base, whitish; stem equal or abruptly contracted at the top, glabrous, spongy within, whitish; spores subglobose, .0003 of an inch broad.

Pileus 2 to 3 inches broad; stem 1 to 1.5 of an inch long, 6 to 8 lines thick. Woods. Denning, Ulster co. August. Rare.

In the dried specimens the pileus has assumed a dull brownish red hue. In report 39 p. 57 this was considered a variety of R. foetens, from which it differs in its granular roughened pileus, its more narrow and close lamellae and the absence of the peculiar odor of that species. Its acrid taste will separate it from R. punctata Gill., its glabrous stem, smaller spores and adnate lamellae from R. granulosa Cke.

Entoloma graveolens *n. sp.*

PLATE D, *fig. 1–7*

Pileus thick, firm but brittle, convex, often irregular, glabrous, slightly flocculent on the margin, whitish, sometimes with a violaceous tint, flesh white, taste unpleasant, odor strong, disagreeable, earthy; lamellae narrow, close, adnexed, grayish white becoming pale salmon color; stem short, stout, solid, thickened or bulbous at the base, downy above, white, the bulb usually clothed with a soft, white tomentum; spores pale salmon color, elliptic, .00024 to .0003 of an inch long, .00016 broad, commonly uninucleate.

Pileus 2 to 4 inches broad; stem 1.5 to 4 inches long, 8 to 12 lines thick. Black muck soil in low woods. Meadowdale. October.

In size and shape this mushroom resembles Tricholoma personatum, and when it is tinged with a violaceous hue the resemblance is increased. Its strong unpleasant odor is very persistent and remains in the dried specimens, and its disagreeable flavor is not destroyed by cooking. It grows in dense clusters and in lines or arcs of circles. The color of the spores and the strong disagreeable odor easily distinguish the species from the masked tricholoma, with which it might otherwise be confused.

Hebeloma pascuense *n. sp.*

PLATE C, *fig. 21–27*

Pileus convex, becoming nearly plane, viscid when moist, obscurely innately fibrillose, brownish clay color, often darker or rufescent in the center, the margin in the young plant slightly whitened by the thin webby veil, flesh whitish, taste mild, odor weak, resembling that of radishes; lamellae close, rounded behind, adnexed, whitish, becoming pale ochraceous; stem firm, short, equal, solid, fibrillose, slightly mealy at the top, whitish or pallid; spores pale ochraceous, subelliptic, uninucleate, .0004 of an inch long, .00024 broad.

Pileus 1 to 2 inches broad; stem 1 to 2 inches long, 2 to 3 lines thick. Gregarious or subcespitose. Stony pastures. Near Warrensburg. October.

The species belongs to the tribe Indusiati. In some of the specimens there is a narrow, brown circumscribing zone or line on the pileus near the margin.

Naucoria pennsylvanica *B. & C.*

Decaying wood. Near Warrensburg. October.

Psilocybe dichroa (*Pers.*) *Karst.*

Swamps and wet places. Karner. October.

Psilocybe unicolor *n. sp.*

Pileus thin, broadly convex, hygrophanous, striatulate and brown when moist, even and pale brown or whitish when dry, flesh white, taste slightly disagreeable; lamellae narrow, thin, close, adnexed, brownish becoming darker with age; stem short, straight or curved, equal, glabrous, stuffed or hollow, brownish, a little paler than the pileus; spores brown, elliptic, .00024 of an inch long, .00016 broad.

Pileus 6 to 10 lines broad; stem 8 to 12 lines long, about 1 line thick. Decaying, prostrate, mossy trunk of some deciduous tree in woods. Savannah, Wayne co.

This species differs from P. camptopus, to which it is closely allied, in its lamellae, which are adnexed and darker colored, and in its stem, which is glabrous, stuffed or hollow and destitute of the conspicuous, white, radiating hairs at the base. In that species the lamellae are at first whitish, becoming reddish brown with age, and the stem is solid, white and sprinkled with white, mealy particles.

Boletus mutabilis *Morg.*

Bare ground in thin woods along streams. Denning. August. Our specimens differ in some respects from the typical form, but in essential characters they agree too well to warrant their separation. The mouths of the tubes are rather small and nearly round, the stem is even, equal or slightly tapering upward, slightly furfuraceous, yellow at the top and sometimes reddish at the base. The spores are greenish brown or olivaceous, .0005 to .0006 of an inch long, .00024 to .0003 broad. The tubes and flesh quickly or instantly become blue where cut or broken.

Trametes ohiensis *Berk.*

Dead wood of deciduous trees and specially on chestnut rails. Howland island near Savannah. October. This species is not sharply separated from T. scutellata (Schw.). It is generally larger and more strongly ungulate and not so black when old. The point of attachment is often more prominent. It is considered a form of the same species by some, but the two are easily distinguished by the eye.

Hydnum populinum *n. sp.*

Resupinate, effused, the subiculum thin, minutely floccose, becoming submembranaceous, adnate, white or whitish, the naked margin very thin, white; aculei scattered or crowded, very short, obtuse, at first papilliform, becoming half a line long, terete or compressed by the confluence of two or more, white, sometimes with a faint pinkish tint; spores white, elliptic, .00024 to .0003 of an inch long, .00012 to .00015 broad.

Dead bark of poplar, Populus tremuloides Mx. Gansevoort. September. It forms patches 2 to 4 inches long. The aculei are scattered near the margin, crowded in the center.

Hydnum combinans *n. sp.*

Subiculum effused, very thin, floccose farinose, adnate, indeterminate, whitish; aculei scattered and whitish on the margin of the subiculum, crowded, subfasciculate and tinged with creamy yellow elsewhere, narrowly conical, rather tough, short, subobtuse and ciliate at the apex; spores subglobose, .00012 to .00016 of an inch broad, containing a single shining nucleus.

Decaying decorticated wood of some deciduous tree. Warrensburg. October.

This species forms very thin patches several inches in extent. The aculei are often united at their bases as in the genus Irpex, and this union is sometimes formed in such a way that the aculei stand in circles and simulate the dissepiments of pores as in the genus Poria. Their shortness and blunt ciliated apexes indicate a close relationship to the genus Odontia. This combination of characters belonging to three genera has suggested the specific name here

adopted. The species is allied to H. farinaceum, from which it differs in its blunt ciliated aculei, and from H. stipatum it may be separated by its conical ciliated aculei.

Grandinia burtii *n. sp.*

Resupinate, thin, adnate, minutely rimose, white or whitish, becoming tinged with creamy yellow, the margin definite, white; granules minute, hemispheric or papillose, numerous, rather close but scarcely crowded; spores broadly elliptic, .00024 of an inch long, .0002 broad. Bark of beech. East Galway, Saratoga co. July. E. A. Burt. Prof. Burt has also collected it on bark of elm in Vermont. In the fresh state he has observed a faint greenish tint in it, but this entirely disappears in drying.

Odontia acerina *n. sp.*

Effused, very thin, ecostate, crustaceous, adnate, following the inequalities of the surface on which it grows, indeterminate, grayish buff or isabelline, verrucae very minute, papilliform, bearing at their apexes one or more pale setae; spores hyaline, elliptic, .0003 of an inch long, .00016 broad.

Dead wood and bark of red maple, Acer rubrum. Montezuma. October.

The species is closely related to O. rimosissima, but it forms a thinner stratum with an indeterminate margin and it is not conspicuously rimose. Its spores are longer than in that species.

The subjoined synoptic table will indicate the prominent disnctictive characters of the New York species of Odontia now known.

	Mycelium forming rhizomorphoid threads	1
	Mycelium not forming rhizomorphoid threads	3
1	Hymenium pallid	2
1	Hymenium brown	fusca
2	Margin fimbriate	fimbriata
2	Margin not fimbriate	tenuis
3	Color red or reddish	lateritia
3	Color not red or reddish	4
4	Margin determinate	5
4	Margin indeterminate	acerina
5	Margin white, byssin	pruni
5	Margin neither white nor byssin	rimosissima

Puccinia asparagi *DC.*

Living stems and branches of asparagus. Whitesboro. September. C. S. Banks. This parasite is often very destructive to its host plant. It has but recently been introduced into our state and it is an additional parasitic fungus, with which our gardeners and asparagus cultivators must contend.

Diplodia conigena *Desm.*

Scales of pine cones. Brooklyn. April. L. H. Peet.

Gloeosporium melanconioides *n. sp.*

Pustules numerous, minute, nestling in the bark, covered by the epidermis which is usually ruptured transversely; spores oozing out and forming masses or globules which are whitish wnen moist, blackish when dry, broadly elliptic, .0004 to .0005 of an inch long, .00024 to .0003 broad, usually containing a single large nucleus; sporophores very short or obsolete.

Bark of pear trees. Geneva. W. Paddock.

The spores are similar to those of Melanconium hyalinum E. & E. in size, but in that species the pustules are larger, the sporophores are longer and the extruded spores form a smoky brown mass.

Acrostalagmus cinnabarinus *Cd.*

Dead stems of carnation pinks. Geneva. F. C. Stewart.

Monilia sitophila (*Mont.*) *Sacc.*

Stale bread. Albany. W. G. Tucker. This is a beautiful mold having a delicate salmon color. In these specimens there was an agreeable odor resembling that of strawberries.

Scleroderma verrucosum maculatum *n. var.*

PLATE B, *fig. 8–12*

Subsessile, globose or depressed globose, 1 to 3 inches broad; peridium thick, firm, brown, adorned with minute, thin, dark brown squamules, which often fall from the upper part, leaving it dotted with small, round, pale or yellowish spots; spores blackish in the mass, globose, warted, .0006 to .0007 of an inch broad; tramal walls yellowish brown.

Mucky soil in woods. Rosendale. September.

The specimens found were too old to show the interior color of the young plant and not old enough to show the manner in which the peridium ruptures. The general color of the peridium is Vandyke brown, and the scales are so minute that at first sight it appears to be smooth. On close inspection it is seen to be abundantly dotted with minute flattened scales, which are so loosely attached that they are apt to fall away, each one leaving a small pale spot or dot on the peridium similar to those left by the falling of the warts from the peridium of Lycoperdon gemmatum. S. verrucosum is said to be very variable in size and color and in the degree of roughness of the exterior. Its warts are described as persistent and adnate. Authors do not agree in their description of the spores, one describing them as minute and another saying that they are larger than those of any other species of this genus. But in no description do I find any reference to the deciduous character of the scales and the consequent dotting of the surface of the peridium which is shown by our specimens. For this reason it has seemed best to separate our plant as a variety worthy of recognition. Possibly a more complete knowledge of it may show it to be worthy even of specific distinction.

D

REMARKS AND OBSERVATIONS

Aconitum noveboracense *Gray*

A newly discovered station for this rare plant is in a deep gorge in the Catskill mountains. The plants were found growing by the side of the road leading from West Shokan to Bullrun.

Sisymbrium altissimum *L.*

Along the railroad near Harrisville. It has evidently been recently introduced in this station. The plants are small and apparently do not thrive in this locality.

Viola communis *Pollard*

An unusually hairy form is plentiful in grassy places at Menands.

Drosera intermedia *Hayne*

It seems strange that the descriptions of this species in our recent botanies take no notice of one of the striking peculiarities of the

plant. The scape is very constantly and conspicuously curved at the base, as if its growth at first was at right angles to the stem and after a time it had changed its direction and grown upward parallel to the axis of the stem. This feature is present in all the specimens I have seen from the eastern and northern parts of the state. The species is not as common with us as D. rotundifolia.

Valerianella locusta (*L.*) *Bettke*

Williamsville, Erie co. May. J. Peter. Introduced.

Aster lowrieanus bicknellii *Porter*

Roadsides about a mile west of Minnewaska. This variety differs from the type in having all the leaves lanceolate. Its close ally, A. lowrieanus lancifolius Porter, which differs from it in having a few of the lower leaves cordate lanceolate, was found growing with it. Neither variety was abundant.

Aster novi-belgii elodes (*T. & G.*) *Gray*

A linear-leaved aster scarcely distinguishable from this seacoast plant was found in Bonaparte swamp.

Solidago macrophylla *Pursh*

The range of this beautiful mountain goldenrod extends southward in the Catskill mountains nearly to the southern limits of Ulster county. A slender form with numerous flower heads was found near Denning.

Solidago odora *Ait.*

Plentiful about Minnewaska, where a form occurs in which the leaves are blunt and slightly mucronate. I find no such form noticed in our descriptive manuals.

Bidens laevis (*L.*) *B. S. P.*

Abundant along the banks of a creek about a mile north of Savannah. It also occurs sparingly on the marshes near that place.

Nabalus trifoliatus *Cass.*

Common about Minnewaska, where it is the prevailing species of this genus. A form occurs occasionally in which the leaves are

divided into narrowly lanceolate or linear lobes, the lobes themselves sometimes having large teeth projecting from the margin. This is so unlike the typical form that I have designated it variety dissectifolius. It has been found at Minnewaska and Sandlake.

Taraxacum taraxacum *(L.) Karst.*

A singular monstrosity of the flower of the dandelion was obtained by Dr E. A. Bartlett and contributed by him to the herbarium. The scape is about 6 lines in diameter and includes within itself another scape of smaller diameter, and this in turn includes a third still smaller. The flower at the top is apparently a combination of several small heads united laterally and forming a circle, whose center is occupied by green, involucral bracts of ordinary size. The exterior of the circle is surrounded by the usual green involucral bracts. Two somewhat similar examples of the same species were found in Schoharie and communicated by Prof. J. M. Clarke. In these, several scapes are apparently united and form a single large one, which is surmounted by five or six crowded but distinct heads of flowers.

Mertensia virginica *(L.) DC.*

Abundant on the river flats near Apalachin. May. F. E. Fenno.

Gentiana crinita *Froel.*

A form growing in meadows about New Russia has pinkish colored flowers. Mrs L. A. Millington.

Bartonia virginica *(L.) B. S. P.*

This rare species grows sparingly in wet places on the large marsh near Kasoag.

Utricularia clandestina *Nutt.*

A rare species in our state. Found in flower in July in shallow water holes of Kasoag marsh.

Utricularia cornuta *Mx.*

Plentiful on Kasoag marsh, growing in soft, muddy places. The plants are thrifty and so numerous that when in flower they give to the places they occupy the appearance of a meadow overrun by buttercups.

Polygonum lapathifolium *L.*

Abundant and variable along the shore of Kinderhook lake. The racemes are slender or stout, erect or slightly nodding, whitish or pinkish red. In one form the leaf has a dark blotch in the center.

Polygonum careyi *Olney*

This species is said to grow in marshes, but tall, thrifty specimens were found near Minnewaska growing in dry ground by the roadside. September.

Polygonum cilinode breve *Pk.*

This variety, which has been collected in two localities in the Adirondacks, was found in August in the Catskill mountains near Denning, growing with the common form and apparently passing into it.

Euphorbia peplus *L.*

Introduced and growing spontaneously at Oneonta. Rev. R. L. Welch.

Chenopodium glaucum *L.*

Found growing in hard, gravelly soil at Menands.

Chenopodium anthelminticum *L.*

A peculiar form, having the inflorescence more conspicuously bracted than usual, was found at Syracuse by Mrs L. L. Goodrich.

Atriplex hastata *L.*

Abundant in some places on the marshes near Savannah.

Populus tremuloides *Mx.*

Young, thrifty shoots or suckers of this tree and of P. grandidentata vary much in their foliage, which differs so decidedly from the leaves of older trees of the same species that it sometimes is a source of much perplexity to young and inexperienced botanists. The botanical descriptions of the manual fail to notice this difference, and the young botanist is apt to think that these young shoots belong to some species not described in our botanies. The leaves are much larger than those of older trees, the serratures of the margin vary, and the lower surface is covered by a dense, persistent tomentum.

Picea mariana *(Mill.) B. S. P.*

This is the common spruce in Bonaparte swamp, near Lake Bonaparte. The terminal shoot of the trunk and of the branches is sometimes glabrous, while the lateral shoots are pubescent. The cones are decidedly larger than those of P. brevifolia and distinctly longer than broad. In both species the seeds, at least in part, are sometimes retained in the cones till the next season.

Cyperus diandrus *Torr.*

Muddy shores of Kinderhook lake. September. A small form.

Scirpus lacustris condensatus *n. var.*

Heads of the panicles sessile or on very short pedicels, forming a dense cluster about 1 inch long and broad. Otherwise as in the common form. Lime Lake. August. F. E. Fenno.

Scirpus microcarpus *Presl.*

Squaw island, Niagara river. J. Peter. Mr Fernald has recently described the eastern plant, referred to this species in our botanies, as a new species, which he names S. rubrotinctus.

Eleocharis acuminatus *(Muhl.) Nees*

Grand island, Niagara river. June. J. Peter.

Carex pauciflora *Lightf.*

Specimens with culms 12 to 20 inches tall were found in wet places on Kasoag marsh. It is usually much smaller.

Sporobolus longifolius *(Torr.) Wood*

Streets of Rosendale. September. This is not a common grass in the eastern part of our state, but it may be easily recognized by the long, narrow, involute leaves which overtop the panicle and often partly conceal it in their sheathing bases.

Agrostis hyemalis *(Walt.) B. S. P.*

A tall, stout form, with widely spreading or nearly horizontal branches of the panicle, occurs about Minnewaska. Its appearance is very unlike that of the usual form of the species.

Sieglingia seslerioides (*Mx.*) *Scribn.*

Plentiful in sandy soil east of Rosendale. September.

Panicum capillare soboliferum *Tuckm.* in ed.

A dwarf variety with culms 1 to 4 inches long, having numerous basal spreading or prostrate branches and spikelets less than 1 line long. This variety indicates a very great degree of variation in this exceedingly variable species. Abundant on the muddy shore of Kinderhook lake. September. The station is exposed only when the water in the lake is low. I am indebted to Prof. F. L. Scribner for the identification of this grass.

Woodwardia virginica *Sm.*

A singular form occurs on Kasoag marsh, in which the pinnae are short and their lobes are much curled and crisped. It has a singularly poor, starved or unthrifty appearance, yet it sometimes grows from the same rootstock which supports fronds of ordinary size and vigor.

Onoclea sensibilis *L.*

A form was collected near Kasoag in which the pinnae on one side of the frond are fertile, on the other, sterile.

Dicranella subulata *Schimp.*

Damp, shaded banks by roadside. Denning. August. Not before found by me in the state, but reported by the late Prof. Lesquereux to occur in the Adirondacks.

Hypnum blandovii *W. & M.*

Davis swamp near Warrensburg. This is a new station for this rare moss.

Jungermannia inflata *Huds.*

Minnewaska. September. In this locality it forms dense cushions on the wet surface of rocks and fruits abundantly.

Peltigera canina spongiosa *Tuckm.*

This variety occurs on Mt Marcy and near Warrensburg.

Cladonia papillaria (*Ehrh.*) *Hoffm.*

Thin soil covering rocks. Minnewaska. September. Fine fertile specimens were obtained.

Cladonia mitrula *Tuckm.*

West Shokan. August. This is the most northern station in which I have found this southern lichen.

Cladonia macilenta *Hoffm.*

About the base of an old stump. Minnewaska. September.

Lecanora hageni *Ach.*

Decorticated surface of hemlock trunk. Savannah. October. The apothecia were very abundant, nearly covering the surface of the wood in patches.

Amanita rubescens *Fr.*

This species is sometimes attacked by a parasitic fungus, which arrests its proper development and usually causes it to appear like a thick, white stem with no cap or only a very rudimentary, unexpanded one. Specimens were found near Denning in which the host plant had been so slightly changed that its identification was possible. When the parasite, which is Hypomyces inaequalis Pk., develops an abundance of perithecia, it sometimes gives a slight salmon hue to the surface of the host.

Amanita frostiana pallidipes *n. var.*

The typical form of this species, which is common in our cool northern woods, has the pileus and annulus and usually the stem also of a yellow color, that of the pileus sometimes verging to orange. But in warmer and more open or bushy places forms occur in which the whole plant is whitish, but in other respects has the characters of the species. Sometimes the pileus is pale yellow and the stem and annulus white. The warts are soft and flocculent, are sometimes numerous and persistent and again are few or wanting. The form with yellow stem and annulus and yellow or orange pileus may be considered the typical form of the species, but forms having the stem and annulus pale or white may be designated as variety pallidipes.

Amanitopsis volvata elongata *n. var.*

PLATE A, *fig. 6–10*

Pileus glabrous, slightly viscid when moist, striate on the margin, white; stem long, straight or variously curved, mealy at the top, floccose squamose below, the bulb buried deeply in the ground.

Under or near pine trees. Claryville. August.

This variety differs from the type in its purer white glabrous pileus, its long stem and in having the bulb deeply buried in the ground. The remains of the ruptured volva are generally more closely pressed about the base of the stem than in the typical form, in which the bulb is above or just at the surface of the ground. In both forms the lamellae change color in drying, becoming much darker than when fresh. The stem is from 4 to 6 inches long. Sometimes the pileus is adorned by one or two small fragments of the volva which adhere to it.

Hygrophorus miniatus sphagnophilus *n. var.*

Pileus broadly convex, subumbilicate, red; lamellae adnate, whitish, becoming yellowish or sometimes tinged with red, occasionally red on the edge; stem colored like the pileus, whitish at the base, both it and the pileus very fragile. Kasoag marsh, growing among peat mosses. July. This is more fragile than the typical form and retains its color better in drying.

Cantharellus cibarius multiramis *n. var.*

Pileus very regular, the margin decurved and the lamellae much branched and anastomosing. Denning. August. The folds or lamellae are so abundantly connected that the hymenium resembles that of C. floccosus.

Lentinus cochleatus *Fr.*

The flesh of this species has a very hot or acrid taste similar to that of Lactarius piperatus.

Entoloma strictius irregulare *n. var.*

PLATE D, *fig. 8–15*

Pileus thin, fragile, campanulate convex or nearly plane, with or without an umbo, often irregular, dark brown and obscurely striatu-

late on the margin when moist, grayish brown when dry; lamellae grayish when young, pale salmon color when mature; stem rather short, often irregular, silky fibrillose, stuffed or hollow, shining, white.

Wet or damp ground. Autumn and spring. Albany and Rensselaer counties.

This differs from the type in its irregular pileus and in its shorter and less straight stem. The pileus becomes variegated with paler stripes while the moisture is escaping from it, but these disappear entirely when the evaporation is completed. The European E. clypeatum, to which it is apparently closely related, is a much larger and stouter plant and is figured as having a solid or merely stuffed stem.

Inocybe geophylla *Sow.*

This species is sometimes quite variable. A group of specimens found growing under pine trees near Warrensburg was composed of specimens having the pileus conic, campanulate or nearly plane, obtuse or umbonate, white or isabelline.

Paxillus involutus simplex *n. var.*

This variety differs from the type in having the lamellae distinct at the base, neither crisped nor anastomosing. Minnewaska. September.

Cortinarius sphagnophilus *Pk.*

Among peat moss, under or near spruce trees in Davis swamp near Warrensburg. October. This species was discovered in 1875 and this is the second time it has been found. The pileus is marked not only with darker spots but also with stripes till the excess of moisture has disappeared. The stem is abundantly silky fibrillose.

Hydnum chrysocomum *Underw.*

Decaying wood and sticks. Montezuma. October. These specimens have the aculei about 1 line long and more acute than in the typical form. The spores are minute, elliptic, .00016 of an inch long, .00008 to .0001 broad.

Thelephora palmata americana *n. var.*

Ultimate branches often slender, terete, pointed, either whitish or concolorous at the apex.

Calostoma cinnabarinum *Desv.*

Fine specimens of this fungus were found in woods near Minnewaska in September. They were growing in vegetable mold and on much decayed wood under a chestnut tree. Specimens were found in August also near West Shokan. This is the most northern station in which I have found this species. It was here growing in damp earth at the base of banks by the roadside. Such places are a favorite habitat of the species.

Puccinia graminis *Pers.*

Specimens of this parasitic fungus were found near Savannah, growing on leaves of reed grass. The parasite had been attacked by another parasitic fungus, Darluca filum, which had manifestly interfered with or modified its usual form of development, as all the teleutospores in the affected sori were single-celled, as in the genus Uromyces.

Hypomyces lactifluorum (*Schw.*) *Tul.*

The author of this species regarded it as inhabiting species of Lactarius, and L. piperatus has specially been credited with the honor of being a host plant for it. It generally changes the form texture and color of its host so much that it is difficult to recognize it. Specimens were received the past season that showed clearly that the chantarelle, C. cibarius, is sometimes attacked by it.

E

PLANTS OF BONAPARTE SWAMP

Lake Bonaparte is in the northern part of Lewis county. Bonaparte swamp is near it on the east side and is about two miles long. The Carthage and Adirondack railroad runs through it and two highways cross it, one near the north end and the other near the south end. There are evidences of old lumber roads in some parts of it. These were probably used in the winter in taking out such wood and lumber as had any value. This swamp occupies an intermediate position between the cold, elevated swamps of the Adirondack region

and those of the lower country south of it. It might therefore be expected to combine to some extent the swamp floras of both regions. To ascertain the character of its flora, a part of two days in July was spent in its botanical exploration. This work was more easy because facilitated by the roads running through the swamp. The resulting list of species found shows it to be a rich botanical field, but doubtless a more extended investigation would add several species to the list, specially if the search could be made both earlier and later in the season. Among the species which may be expected to occur, but which were not seen, are Coptis trifolia, Viola cucullata and V. communis, Aster acuminatus, Viburnum cassinoides, Spiraea salicifolia, Dalibarda repens, Vaccinium corymbosum, V. canadense and V. pennsylvanicum, Kalmia angustifolium, Pogonia ophioglossoides, Veratrum viride, Calla palustris, Arisaema triphyllum, Carex intumescens, C. monile and C. trisperma.

The large proportion of shrubs and trees shows that much of the swamp has passed beyond the soft, marshy condition, which is unfavorable to such plants. Yet marshy spots are not wholly absent, as the presence of the small cranberry, Oxycoccus oxycoccus, the grass pink, Limodorum tuberosum, the showy lady's-slipper, Cypripedium reginae, and the white bog orchis, Habenaria dilatata, indicates. The carices are specially well represented, no less than 18 species being recorded; while of grasses only 10 species were seen. Phragmites phragmites, the reed grass, is one of the most stately and interesting of these. Among the rare plants are the swamp valerian, Valeriana sylvatica, the slender spike-rush, Eleocharis tenuis, and the low birch, Betula pumila. This birch is plentiful and fruits freely. The narrow lady-fern, Asplenium filix-foemina angustum, occurs here in a form having fronds only about 2 inches broad. The number of species found is 129. Their names are given below.

Osmunda regalis *L.*
O. cinnamomea *L.*
Onoclea sensibilis *L.*
Dryopteris thelypteris (*L.*) *Gray*
Asplenium filix-foemina (*L.*) *Bernh.*

Equisetum fluviatile *L.*
Picea mariana (*Mill.*) *B. S. P.*
P. brevifolia *Pk.*
Abies balsamea (*L.*) *Mill.*
Thuja occidentalis *L.*

Taxus minor (*Mx.*) *Britton*
Typha latifolia *L.*
Sparganium simplex *Huds.*
Potamogeton foliosus *Raf.*
Sagittaria latifolia *Willd.*
Muhlenbergia racemosa (*Mx.*) *B. S. P.*
Agrostis alba *L.*
A. hyemalis (*Walt.*) *B. S. P.*
Calamagrostis canadensis (*Mx.*) *Bv.*
Phragmites phragmites (*L.*) *Karst.*
Poa flava *L.*
Panicularia canadensis (*Mx.*) *Kuntze*
P. elongata (*Torr.*) *Kuntze*
P. americana (*Torr.*) *MacM.*
P. pallida (*Torr.*) *Kuntze*
Eleocharis palustris (*L.*) *R. & S.*
E. tenuis (*Willd.*) *Schultes*
Scirpus sylvaticus *L.*
S. cyperinus (*L.*) *Kunth*
S. atrovirens *Muhl.*
Eriophorum gracile *Koch*
E. polystachyon *L.*
E. virginicum *L.*
Carex utriculata *Boott*
C. retrorsa *Schw.*
C. lurida *Wahl.*
C. hystricina *Muhl.*
C. pseudo-cyperus *L.*
C. stricta *Lam.*
C. filiformis *L.*
C. limosa *L.*
C. magellanica *Lam.*
C. leptalea *Wahl.*
C. exilis *Dew.*
C. stipata *Muhl.*
C. teretiuscula *Gooden.*
C. vulpinoidea *Mx.*
C. tenella *Schk.*
C. sterilis *Willd.*
C. scoparia *Schk.*
C. tribuloides *Wahl.*
Juncus effusus *L.*
J. canadensis *J. Gay*
Clintonia borealis (*Ait.*) *Raf.*
Unifolium canadense (*Desf.*) *Greene*
Iris versicolor *L.*
Cypripedium reginae *Walt.*
Habenaria dilatata (*Pursh*) *Hook.*
Limodorum tuberosum *L.*
Myrica gale *L.*
Salix lucida *Muhl.*
S. bebbiana *Sarg.*
S. discolor *Muhl.*
S. sericea *Marsh.*
S. candida *Fluegge*
S. myrtilloides *L.*
Betula papyrifera *Marsh.*
B. lutea *Mx. f.*
B. pumila *L.*
Alnus incana (*L.*) *Willd.*
Razoumofskya pusilla (*Pk.*) *Kuntze*
Rumex britannica *L.*
Nymphaea advena *Soland.*
Caltha palustris *L.*
Thalictrum polygamum *Muhl.*
Sarracenia purpurea *L.*
Drosera rotundifolia *L.*
Tiarella cordifolia *L.*
Mitella nuda *L.*
Ribes rotundifolium *Mx.*
R. rubrum *L.*
Rubus americanus (*Pers.*) *Britton*
Geum rivale *L.*
Aronia arbutifolia (*L.*) *Ell.*
Amelanchier canadensis (*L.*) *Medic.*
Ilex verticillata (*L.*) *Gray*
Ilicioides mucronata (*L.*) *Britton*
Acer rubrum *L.*
Impatiens biflora *Walt.*
Rhamnus alnifolia *L'Her.*
Triadenum virginicum (*L.*) *Raf.*
Viola blanda *Willd.*
Isnardia palustris *L.*
Chamaenerion angustifolium (*L.*) *Scop.*
Epilobium lineare *Muhl.*
E. strictum *Muhl.*
E. adenocaulon *Haussk.*
Sium cicutaefolium *Gmel.*
Cicuta bulbifera *L.*
Cornus canadensis *L.*
C. stolonifera *Gmel.*
Andromeda polifolia *L.*
Chamaedaphne calyculata (*L.*) *Moench*
Ledum groenlandicum *Oeder*
Oxycoccus oxycoccus (*L.*) *MacM.*
Naumbergia thyrsiflora (*L.*) *Duby*
Fraxinus nigra *Marsh.*
Menyanthes trifoliata *L.*

Trientalis americana *Pursh*
Lycopus virginicus *L.*
Chelone glabra *L.*
Mimulus ringens *L.*
Utricularia vulgaris *L.*
Galium triflorum *Mx.*
G. trifidum *L.*
Viburnum opulus *L.*
Linnaea borealis *L.*
Valeriana sylvatica *Banks*
Campanula aparinoides *Pursh*
Lactuca canadensis *L.*
Eupatorium perfoliatum *L.*
Solidago uliginosa *Nutt.*
S. serotina *Ait.*
S. canadensis *L.*
Aster puniceus *L.*
A. novi-belgii *L.*
A. tradescanti *L.*
Doellingeria umbellata (*Mill.*) *Nees*
Bidens cernua *L.*

EXPLANATION OF PLATES

PLATE A

Amanita calyptrata albescens *Pk.*

CALYPTRATE AMANITA

FIGURE

1 Plant with cap partly expanded

2 Plant with cap fully expanded

3 Vertical section of the upper part of a plant

4 Transverse section of a stem

5 Four spores × 400

Amanitopsis volvata elongata *Pk.*

TALL AMANITOPSIS

6 Plant with cap partly expanded

7 Plant with cap fully expanded

8 Vertical section of the upper part of an immature plant

9 Vertical section of the upper part of a mature plant

10 Four spores × 400

PLATE B

Amanita multisquamosa *Pk.*

VERY SCALY AMANITA

1, 2 Plants with caps partly expanded

3 Plant with cap fully expanded

4, 5 Plants with caps wholly white

6 Vertical section of the upper part of a mature plant

7 Four spores × 400

Scleroderma verrucosum maculatum *Pk.*

SPOTTED SCLERODERMA

8 Small plant

9, 10 Larger plants, showing small pale spots on the upper part of the peridium

11 Vertical section of a plant

12 Four spores × 400

PLATE C

Russula granulata *Pk.*

GRANULATED RUSSULA

FIGURE	
1, 2	Plants with caps partly expanded
3	Plant with cap fully expanded
4	Vertical section of the upper part of a plant
5	Four spores × 400

Russula flaviceps *Pk.*

YELLOW CAP RUSSULA

6, 7	Plants with caps partly expanded
8	Plant with cap fully expanded
9	Vertical section of the upper part of a mature plant
10	Four spores × 400

Hygrophorus subviolaceus *Pk.*

VIOLACEOUS HYGROPHORUS

11	Young, moist plant
12	Mature, moist plant
13	Mature plant with cap destitute of moisture
14	Vertical section of the upper part of a plant
15	Four spores × 400

Clitocybe centralis *Pk.*

CENTRAL CLITOCYBE

16, 17	Plants with moist caps
18	Plant with cap destitute of moisture
19	Vertical section of the upper part of a plant
20	Four spores × 400

Hebeloma pascuense *Pk.*

PASTURE HEBELOMA

21, 22	Two immature plants
23, 24	Two mature plants, one with a colored band near margin of cap
25	Vertical section of the upper part of an immature plant
26	Vertical section of the upper part of a mature plant
27	Four spores × 400

PLATE D

Entoloma graveolens *Pk.*

STRONG SMELLING ENTOLOMA

FIGURE
1, 2 Two young plants
3 Young plant with cap violet tinted
4 Cluster of three plants, the central one mature
5 Vertical section of the upper part of an immature plant
6 Vertical section of the upper part of a mature plant
7 Four spores × 400

Entoloma strictius irregulare *Pk.*

IRREGULAR ENTOLOMA

8, 9 Two plants with moist caps
10, 11 Two plants with caps not moist, one mature and its cap umbonate
12 Vertical section of the upper part of an immature plant
13 Vertical section of the upper part of a mature plant
14 Transverse section of a stem
15 Four spores × 400

FUNGI

C H PECK, del

C FAUSEL, LITH

JAMES B LYON, STATE PRINTER

FIG 1-5 AMANITA CALYPTRATA ALBESCENS PK.

CALYPTRATE AMANITA

FIG 6-10 AMANITOPSIS VOLVATA ELONGATA PK.

TALL AMANITOPSIS

FUNGI

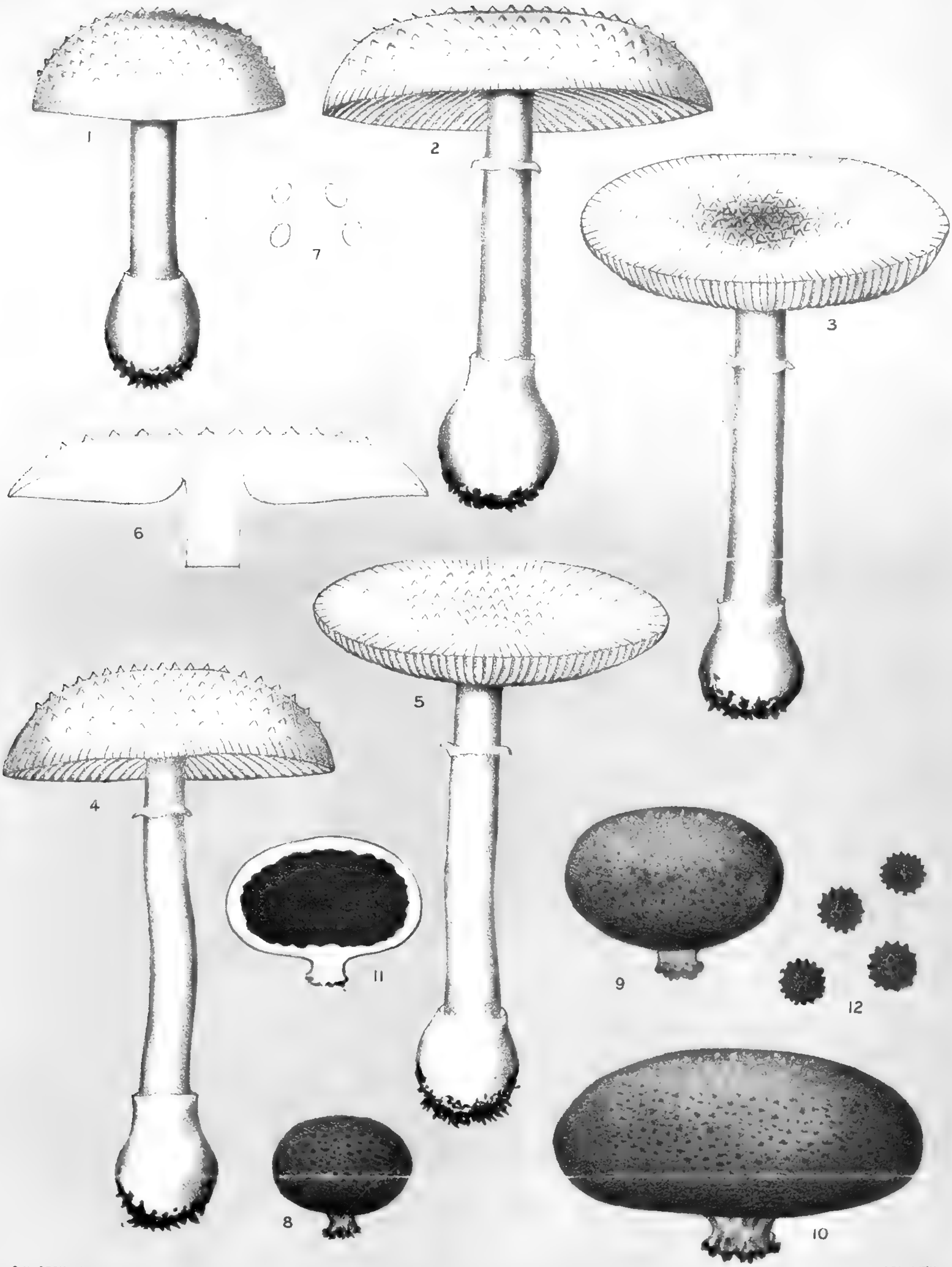

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Fig. 1 to 7 **AMANITA MULTISQUMOSA** Pk.
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